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THE MEMORY IMAGE AND ITS QUALITATIVE FIDELITY.

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CHAPTER I.

LITERATURE AND METHODS.

The problem which is approached in the following pages was suggested by the sections on "Central erregte Empfindungen" in Professor Kuelpe's "Grundriss der Psychologie."[1] The author here expresses the belief that much work on memory has assumed, without sufficient cause, the presence of a memory image; too often, he thinks, the term 'memory image' has been used to cover the remnants of past experiences, whatever their relations to consciousness. As a consequence, the interpretation of results has not always been reliable. In referring to the associational school of psychology, to which this mistake is, in part, traceable, Kuelpe contends that its

[1] "Es ist aber auch erforderlich zu betonen, dass die reproducirten Empfindungen keineswegs die einzigen Hilfsmittel der Erinnerung sind" (*op. cit.*, p. 188). And concerning recognition Kuelpe says (p. 212): "Wenn man nun in den Fällen, wo eine Empfindung *a* peripherischen Ursprungs daraufhin beurtheilt werden musste, ob sie einer anderen früher erlebten *b* gleich sei oder nicht, angenommen hat, es finde dann eine Vergleichung von *a* mit dem Erinnerungsbilde von *b*, das wir β nennen wollen, statt und es hänge dann von der Treue, mit der β dem *b* entspricht, ab, mit welchem Grade von Sicherheit und Richtigkeit das Urtheil erfolge, so ist dies eine Construction, die nach unserer Erfahrung den Thatsachen keinen angemessenen Ausdruck gibt. Das Urtheil 'gleich' oder 'verschieden' wird vielmehr in der Regel ebenso unmittelbar abgegeben, wie beim unmittelbaren Wiedererkennen das Urtheil 'bekannt.'"

schema for mental contents—sensations and their weak copies, ideas—is inadequate, and even unjust to experience. Since the days of Locke, we may say, the notion of memory as a faint likeness of perception, and of 'reproduction' as a revival through imagery, has been a common one in psychology. In view of the present limitations of 'associationism,' criticism of such a notion is hardly to be avoided where rigid analysis takes its place alongside logical arrangement in psychological work.

Bearing in mind this fact, we have tried to determine the exact place of the image in the memory consciousness, and have then endeavored to discover the changes which the image undergoes in the course of time. We have set ourselves (1) to examine critically the place given the image in the memory literature, (2) to discuss the nature and function of the image and its genetic significance, and (3) to isolate the image for experimental investigation.

Although the existence and general nature of the memory image were early discussed both in and out of psychology, its more precise investigation has waited longer than most memory problems. The fact that its isolation is secured with difficulty accounts partially for this. Its neglect seems, however, to be mainly traceable to the direction from which the psychology of memory has been approached.

A history of the contributions to memory is not called for here. Several lists of the literature, more or less complete, have been made.[1] A brief sketch of the memory methods and a reference to the aspects of memory investigated will, however, be an aid to perspective and indicate at what point our own work touches the general problem.

The first problem of memory to receive wide attention was the 'reappearance' of past events through the mediation of association. As early as Aristotle, 'laws of association' were formulated which were intended to state the conditions under which ideas are brought again to the mind. Aristotle's formulation was so successful that it has passed current, with but minor modifications, until modern times. In the Empirical school of England the bipartite division of mind into 'impressions' and 'ideas,' and the attempt at analysis, brought again into prominence the concept of association. The well-known doctrine of this school, as just now indicated, asserts that ideas are stored-away sensations, and the task of their evocation is laid upon the 'laws of association,' which thus become of prime

[1] For a general and historical aperçu, see W. H. Burnham (*Amer. Jour. of Psych.*, Vol. II,) on "Memory Historically and Experimentally Considered." A recent experimental bibliography on the subject is given by F. Kennedy, *Psych. Rev.*, V, p. 477; this is, unfortunately, full of minor inaccuracies.

importance for knowledge. As every idea has been before presented as an impression (whence the famous dictum, "nihil est in intellectu, quod non prius fuerit in sensu") its reappearance through association is—so far as the arrangement of the elements is unchanged[1]—an act of memory. It is memory, then, as 'reproduction,' which the traditional English psychology emphasizes.[2]

The doctrine of association is not confined to British borders. The German Empirical psychology of the last century accepted it in a modified form. Such representative writers as Hissmann, Maass and Jacob give association a prominent place in their systems, but do not put upon it so much of the onus of mental synthesis as the developed English school does. A new scheme of reproductive motivation is advanced. There is developed the idea of a more active principle in mind. Ideas are not acted upon, but act. Leibniz' exception, *nisi ipse intellectus*, to the above-quoted dictum finds approval among German psychologists. The *Einbildungskraft* occupies an important place in their outlines. The laws of association, says Tetens (*Phil. Versuche*, pp. 108 ff.), have been over-estimated; they do not exhaust the creative activity of the mind. Reproduction as an active principle receives a more exact formulation later by Herbart and his followers. From the *Vorstellungsthätigkeit* Herbart constructs an elaborate scheme of reproduction. The tendency of the idea is, for Herbart, toward reappearance, and the success of rivals becomes a matter of mathematical calculation.

With the rise of experimental methods, memory attracts investigation in its own name. Among the incentives to recollection, association still holds a prominent place, and some of the inquiries[3] into it throw light incidentally upon various aspects of memory; but it is chiefly to direct investigation into memory itself that we must look for elucidation of memory problems.

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[1] *Cf.* Hume. It seems at first strange that Hume should make the laws of association relate to the imagination instead of to the memory. He comes to this, however, because he is thinking of a *changed* order among ideas, and only a *preserved* order belongs to the memory. The rearrangement of elements is work for the imagination. *Treatise*, bk. I, pt. I, Secs. III and IV.

[2] Spencer, one of its later representatives, thus connects association and memory: "Manifestly, associability and revivability go together; since, on the one hand, we know feelings to be associable only by the proved ability of one to revive another, and since, on the other hand, the revival of any feeling is effected only through the intermediation of some feeling or feelings with which it is associated." *Prin. of Psych.*, I, 251.

[3] Among these are the works of Galton, Trautscholdt, Cattell, Scripture, Bergström, Jastrow, Calkins, Lehmann, Höffding, Offner.

After a glance at the literature, with reference to methods pursued, we shall have to consider how far the problems which memory presents to psychology have been disposed of and what still remains to be done. We shall endeavor to show that the science has taken up the problems from the standpoint of popular and pedagogical interest and has still before it much work, both in the analysis of the memory consciousness and in relating memory to mental processes in general. Afterward, taking up the memory image in particular, we shall outline a static and a genetic account of it which we hope may receive confirmation through special experimental investigation.

First in regard to method. The emphasis laid upon the function of 'reproduction' in the descriptive writings that we have touched upon is carried over into experiment, and we have to take account of a well-defined "method of Reproduction." Co-ordinate with this stands the "method of Recognition." This latter method was suggested by the fact that reproduction, even with the most favorable incentives, does not bring to light all that is retained of a past event. The power to recognize on the recurrence of a stimulus has become a favorite test for memory. These two methods, Reproduction and Recognition, cover practically all the experimental work on memory.

I. Under *Reproduction* we have the following contributors: Ebbinghaus,[1] who deals with the capacity of retention, measuring it by the ratio of retained to forgotten, and with various conditions of retention, *i. e.*, length of series, meaning, time interval, repetition, order, rhythm; Müller and Schumann,[2] who used E's materials with improved apparatus (Müller and Schumann extend E's results and make a special study of rhythm as a condition of retention); Jacobs,[3] who uses E's method with school children; Smith, T. L.,[4] the same method applied to muscular memory. The character and simplicity of stimulus, combination of sense modes involved, association and order, effect of age and race, and individual differences, as well as the conditions already named, have been investigated by Paneth,[5] Münsterberg,[6] Bourdon,[7] Lewy,[8] Bigham,[9] Baldwin,

[1] "Das Gedächtnis," 1885.

[2] "Exp. Beiträge z. Untersuchung d. Gedächtnisses." *Zeitsch. für Psych.*, VI, pp. 81 and 257.

[3] "Exps. on Prehension." *Mind*, XII, p. 75.

[4] "On Muscular Memory." *Amer. Jour. of Psych.*, VII, p. 453.

[5] "Versuche ü. den zeitlichen Verlauf d. Gedächtnisses." *Centralblatt für Physiol.*, IV, p. 81.

[6] *Beiträge z. exp. Psych.*, Heft IV, p. 69.

[7] "Infl. de l'age sur la mém. immed:" *Revue philos.*, XXXVIII, p. 148.

[8] "Exp. Untersuchungen ü. das Gedächtnis:" *Zeitsch. für Psych.*, VIII, p. 231.

[9] "Studies from Harvard Psych. Lab.:" *Psych. Rev.*, I, pp. 34 and 453

Shaw and Warren,[1] Smith, W. G.,[2] Barth,[3] Bolton,[4] Kirkpatrick,[5] Schneider,[6] Smith, W. G.,[7] Whitehead,[8] Hawkins,[9] Daniels,[10] Beaunis,[11] Binet and Henri,[12] Xilliez,[13] Bowditch,[14] Jastrow,[15] Courtier,[16] Vaschide,[17] Shaw,[18] Scripture,[19] Henri, V. & C.,[20] Cohn,[21] Philippe,[22] Wolfe,[23] Galton,[24] Scripture.[25]

II. The method of *Recognition* is represented by the following: Weber[26]—visual lengths and weights, Wolfe and Hirschberg[27]—tones, Lehmann[28]—brightnesses and odors,

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[1] "Memory for Square Size:" *Princeton Studies*, Sept., 1895.

[2] "The Relation of Attention to Memory:" *Mind*, N. S. IV, p. 47.

[3] "Untersuchungen ü. den Ortsinn u. ü. das Gedächtnis desselben:" Dorpat, 1894.

[4] "Growth of Memory in School Children:" *Am. Jour. of Psych.*, IV, p. 362.

[5] "An Experimental Study of Memory:" *Psych. Rev.*, I, p. 602.

[6] "Ueber das Gedächtnis f. active Bewegungen:" Dorpat, 1894.

[7] "The Place of Repetition in Memory:" *Psych. Rev.*, III, 21.

[8] "Visual and Aural Memory Processes:" *ibid.*, III, 258.

[9] "Memory Types:" *ibid.*, IV, 289.

[10] "Memory After-image and Attention:" *Am. Jour. of Psych.*, VI, 558.

[11] "Récherches sur la mémoire des sensations musculaires:" *Rev. philos.*, XXV, 569.

[12] "La simulation de la mémoire des chiffres:" *Rev. scient.*, LI, 711; and "De la mém. vis. des enfants:" *Rev. philos.*, XXXVII, 348; also *L'Année psychol.*, I, pp. 1 and 24.

[13] "La continuité dans la mém. immed.," etc.: *Année psychol.*, II, 193.

[14] "A Comparison of Sight and Touch:" Bowditch and Southard: *Jour. of Physiol.*, III, 232.

[15] "Perception of Space by Disparate Senses:" *Mind*, XI, 539; and "Memory and Association:" *Educ. Rev.*, II, 442.

[16] "Communication sur la mém. mus:" *Dritter Intern. Cong. f. Psych.*, p. 238.

[17] "Récherches exp. sur la mém. des lignes:" *Dritter Intern. Cong. f. Psych.*, p. 454: and "Sur la localisation des souvenirs:" *L'Année psychol.*, III, 199.

[18] "A Test of Mem. in School Children:" *Ped. Sem.*, IV, 61.

[19] "Researches on Mem. for Arm Mvmts:" *Yale Stud.*, V, 90.

[20] "Enquête sur les prem. souvenirs de l'enfance:" *L'Année psychol.*, III, 184.

[21] "Exp. Untersuchungen ü. das Zusammenwirken des akustisch-motorischen u. des visuellen Gedächtnisses:" *Zeitsch. für Psych.*, XV, p. 161, and *Dritter Intern. Cong.*, p. 456.

[22] "Un recensement d. images mentales:" *Rev. philos.*, XLIV, p. 508, and "Les transformations de nos images mentales:" *ibid.*, XLIII, p. 481.

[23] "Size of Familiar Objects:" *Am. Jour. of Psych.*, Jan., 1898.

[24] "Exps. on Psychometric Measurements:" *Brain*, II, p. 149.

[25] "Ueber den assoc. Verlauf der Vorstellungen:" *Phil. Stud.*, VII, p. 50.

[26] *Der Tastsinn und das Gemeingefühl*, 1851.

[27] "Untersuchungen ü. das Tongedächtnis:" H. K. Wolfe: *Phil. Stud.*, III, p. 534: v. Art. by W. v. Tschisch: *Dritter Intern. Cong. f. Psych.*, p. 106.

[28] "Ueber Wiedererkennen:" *Phil. Stud.*, V, p. 96.

Münsterberg[1]—colors and digits, Bigham[2]—visual and auditory complexes, Baldwin, Shaw and Warren[3]—memory for square size, Schumann and v. Tschisch[4]—sounds, Loewenton[5]—space memory for the skin, Binet (*cf.* under "Reproduction")—memory for visual lengths, Bourdon[6]—letters and words, Dauriac[7]—music, Landau[8]—muscular sensations, Saborski[9]—memory for shadows.

Beside these methods, A. Binet suggests[10] the methods of *Comparison* and of *Description*. The first of these indicates a comparison of a memory with a perception and a judgment of likeness or difference; the second, as the name implies, simply a description from memory. Binet reserves the term recognition for the selection from a series of a given remembered member. J. M. Baldwin uses the method that Binet calls *Comparison*, and designates it *Identification;* Binet's *Recognition* he styles *Selection*.[11]

We have taken the words 'reproduction' and 'recognition' as convenient rubrics under which to bring various bits of work from many independent sources. These fragments represent divergent schools of method and many different points of view. The words reproduction and recognition are, however, in common usage, and, in order to an evaluation of results, they demand a critical estimate.

First concerning reproduction. It has been pointed out that the terms reproduction and recollection are extremely liable to misunderstanding.[12] The 'copy' view of memory ideas fostered

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[1] "Studies from Harvard Psych. Lab.:" *Psych. Rev.*, I, p. 84.

[2] *Ibid.*, p. 453.

[3] *Princeton Studies*, Sept., 1895.

[4] "Ueber das Gedächtnis für Komplexe regelmässig aufeinander folgender gleicher Schalleindrücke:" F. Schumann: *Zeitsch. für Psych.*, I, p. 75: W. v. Tschisch: *Dritter Intern. Cong. f. Psych.*, p. 95.

[5] "Versuche ueber das Gedächtnis im Ber. des Raumsinnes der Haut:" Dorpat, 1893.

[6] "Obs. comp. sur la reconnaissance, la discrimination et l'association:" *Rev. philos.*, XL, 153.

[7] "La mém. musicale:" *ibid.*, XXXIX, 400.

[8] Das Gedächtnis für Muskelsinn: *Wissenschaftl. Revue*, 1896.

[9] "Ueber das Gedächtnis f. Gesichtswahrn.:" Dorpat, 1894.

[10] *See Introd. à la psychologie exp.*, 1894, chapter on *Memory*, and experimental articles in *Revue philosophique*.

[11] *See Report of the Amer. Psych. Assoc.* for 1893, *Psych. Rev.*, II, 236, and *Année biolog.*, I, 607. Naturally the corresponding methods differ somewhat in detail in the hands of the two independent investigators. It is to be noted that Binet's classification falls, in point of time, between Professor Baldwin's report and later publication.

[12] *Cf.* F. H. Bradley (*Principles of Logic*, bk. II, Part II, ch. 1,), who criticises these concepts from the standpoint of logic.

O. Kuelpe, *op. cit.*, pp. 189-90.

J. Ward: *Mind*, N. S. Vol. II, p. 361. Dr. Ward says: "thus re-

the notion that reproduction is the sole vehicle of memory. Perceptions were reanimated, and brought to their new incarnation knowledge of their previous existence. Kuelpe has pointed out that so far from reproductions being merely weakened copies of sensations, they may vary in a number of ways from the latter. In fact, that recollection may be satisfied with one of a great number of marks or 'tags' by which a consciousness may refer to the past. He further makes evident that the similarity of a peripheral and a reproduced sensation is often remote, and at best the reproduced sensation is only schematic, and demands various aids, such as words, movements, organic sensations and feelings, to complete recollection (pp. 186-9). These aids may, in fact, become the real vehicle of retention, and one and the same memory stimulus may hold at its disposal a number of them. A visual stimulus, *e.g.*, may be remembered, not by a visual image alone, but by a number of auxiliary processes. There is, here, in short, a principle of vicarious functioning among mental contents. An instance may make the point clear. The writer set himself to memorize a series of digits shown successively from a drop behind a screen. Upon trying to reproduce the series immediately he found that recollection could be mediated in any of the following ways: (1) through visual images, (a) successive in time or space, or (b) grouped—hundreds, thousands, etc.,—*plus* motor memory; (2) auditory-motor images; (3) muscular images, through (a) the throat, or (b) spatial position on the table before him, indicated by pointing with the hand; or (4) the digits were retained by the imaged sound, and translated back into visual terms. Again, with a more complex series, reproduction may be aided by recognition of stimuli presented visually or auditorily. This instance will serve to show, further, the extensive field for analysis in determining, not *how much* of a simple or complex presentation can be retained for a given time under given conditions—external and internal—but *what* is the nature of the memory consciousness.[1]

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tentiveness, recognition, reminiscence, recollection are more or less lumped together as 'memory.' Ideas are described as 'faint impressions' due to central excitation; and all complexity, ascertained or inferred, is put down to 'association.' In consequence the lower animals are often credited with ideation and memory on evidence that only warrants the attribution of perception. Yet there are facts enough in human experience that show the wide difference between perception and ideation; but these facts are too liable to be confused so long as the same term 'reproduction' is applied both to the 'representative element' in perception and to the free ideas of memory and imagination."

[1] Since this chapter was written, this aspect of the subject has been again brought into prominence by Dr. Kennedy: *op. cit.*, p. 483.

Next concerning Recognition. The experimental investigation of memory through recognition dates from E. H. Weber's work with lines and weights. Weber noted that accuracy of recognition decreased with time, so that small differences became, after a time, imperceptible. Wolfe's study of tonal memory has already been referred to. He follows Ebbinghaus in seeking a ratio for amounts retained and forgotten, but uses instead of reproduction the method of recognition. The modus of recognition Wolfe assumes to be the comparison of a stimulus with a memory image. He says: "Gehen wir näher auf das Verfahren beim Vergleichen zweier durch einen Zeitraum getrennten Töne ein, so ist klar, dass ohne ein Erinnerungsbild des ersten Tons eine Vergleichung überhaupt unmöglich ist. Dieses Erinnerungsbild ist gewissermassen der Massstab an welchen der zweite oder Vergleichston gemessen wird. Bliebe das Bild in unserer Erinnerung unverändert, so wurde, wenn unsere Apperception dem Reize genau entspricht, der kleinste Unterschied immer bekannt werden." This memory image, according to Wolfe, may be already in consciousness when the second tone comes, or the second tone may call it forth (*loc. cit.*, pp. 556–58). Lehmann later uses the method to settle the respective claims of contiguity and similarity as associational connectives. Lehmann worked chiefly with gray discs. He accepts (*loc. cit.*, pp. 118–19) Wolfe's assumption of the memory image for recognition of simple objects, and concludes that, for the memory of grays, recognition consists in (1) the visual image or (2) a name. Through the mediation of this image Lehmann finds an association by contiguity sufficient for all cases of simple recognition. This result we are not here directly concerned with; but the assumption of the image upon which the result rests we shall have occasion to criticise in connection with our own investigations.

Lehmann's work was followed by a long discussion on "Wiederkennen" by Professor Hoeffding[1] in the "*Vierteljahrsschrift*" (1889–90). Like Lehmann, Hoeffding approaches the problem of recognition from the side of association. He discusses "Immediate Recognition,"[2] where no reference to the past or to attendant circumstances is traceable, and finds in place of an explicit association by which the presentation is known, a "quality of knownness" (*Bekanntheitsqualität*). The 'thing-known' consciousness refuses to be analyzed further than this: it is a case of implicate (*gebundene*) memory.

[1] Dr. Lehmann's earlier article (1889) has special reference (*l. c.* p. 97) to Hoeffding's doctrine of Association as set forth in his "Psychologie in Umrissen."

[2] An instance: a foreign word which one cannot translate but which has yet a familiar sound (*loc. cit.*, 1889, p. 425).

Whatever reproduction there is fuses with the presentation and loses its freedom.[1] The quality of knownness corresponds to increased facility of disposition[2] among nervous elements. Lehmann criticises this view, and doubts that ease of molecular movement in the cortex could be paralleled by a new conscious quality, *i. e.*, that ease of movement should have as independent a conscious concomitant as movement itself (*Phil. Stud.*, VII, pp. 180 ff.). Immediate recognition is, he says, complex and demands the presence of a memory image, or, at least, a name. Lehmann further does the impossible (according to Hoeffding), and brings immediate recognition under experimental conditions. He shows that odors may be pronounced 'known' without the arousal of any association, even a name. In these cases Lehmann assumes an association whose associated member is subliminal. This brings immediate recognition under the head of contiguity association, but only by doubtful reference to 'unconscious reproduction.' Lehmann's further point, that the feeling tone of odors varies independently of the 'knownness' or 'unknownness' of the stimulus, and hence cannot mediate recognition, is overruled if the feeling of recognition is assumed to be unique. This assumption has lately been supported by Professor Washburn (*Phil. Rev.*, VI,

[1] *Cf.* Spencer's scheme of Association. He says (*Princ. of Psych.*, Vol. I, p. 256): ". . . . The primary and essential association is between each feeling and the class, order, genus, species and variety of preceding feelings like itself. This association . . . . constitutes the very recognition of each feeling." A. Bain takes a similar position (*Senses and Intellect;* third ed., p. 458). Dr. Ward, criticising this view, says: "The characteristic peculiarity of this process of assimilation or immediate cognition is that there are not two presentations, A and B, directly given as a part of the fact to be explained. Two presentations have simply been assumed in order to bring assimilation within the range of the more comprehensible processes of association." (*Loc. cit.*, p. 353.)

Ward prefers to call the process of recognition assimilation, and emphasizes its subjective, apperceptive side. "The mere sense of familiarity or facility is then but a subjective state partly active, partly emotional." (p. 532.)

There has been some confusion, in the literature, of 'cognition,' 'association,' and 'recognition.' On this see A. Allin, *Amer. Jour. of Psych.*, VII, pp. 237 ff., February, 1896; also M. W. Calkins, *Psych. Rev., Monograph Supplement*, February, 1896.

[2] Ward criticises Hoeffding for wavering between nascent ideas and a feeling caused by ease through repetition, as explanations of immediate recognition. The criticism seems to us perfectly just. M. Offner (*Philos. Monatshefte*, 1892, pp. 406 ff.) argues that the ease in recognition must be translated into some other terms in order for the presentation to be known as a repetition. Hence it is not ultimate, *i. e.*, it is not 'immediate recognition.' *Cf.* Külpe, *op. cit.*, p. 179.

For the physiology of Hoeffding's 'ease' *cf.* Van Biervliet; *La Mémoire*, 1893.

p. 267), who makes the feeling of recognition a "peculiar property of centrally excited sensations,"[1] and suggests that it may be paralleled by excitation of connective brain tracts which mediate such sensations. These connective tracts thus perform a function for feeling similar to the ideational function which Spencer gave them as substrate for ideas of relation (*Princ. of Psych.*, I, p. 270). Wundt also speaks of a 'feeling of recognition' (*Phil. Stud.*, VIII, pp. 351–5), but demands ideas in the background. Professor Baldwin's explanation (*Mental Development*, 1895, pp. 313 ff.) differs from Hoeffding's only in placing the 'ease' of recognition in motor phenomena connected with the attention. An attempt at analysis of what Hoeffding calls the quality of knownness has been made by Kuelpe. Kuelpe thinks that it consists "(1) in the especial effectiveness for central excitation of familiar impressions or memory images, and (2) in the characteristic mood which they ordinarily induce and which embraces both pleasurable (or at least comfortable) affective states[2] and the corresponding organic sensations" (*loc. cit.*, p. 178).

Later investigations of recognition (see list above) add little to the method. The process of recognition is left in an unsettled state, though its quantitative expression of retention has been much dwelt upon. The discussions at least raise a doubt whether reproduction, in its real sense, and recognition do not stand for quite different processes. This point awaits further investigation.

The method of *Comparison* (Binet) is easily brought under Recognition in the broad sense in which we have used the latter word. In the meaning that Binet gives the terms the chief difference seems to consist in the number of decisions made by the observer. In his Recognition (Baldwin's Selection), unlikenesses are observed until the desired member of the series is found, and then a judgment of likeness is passed: in his Comparison (Baldwin's Identification), one judgment of likeness or difference suffices, *i. e.*, Recognition is reduced to its lowest terms as regards its object.

Description, similarly, for present purposes of classification, may be subsumed under Reproduction: it is verbal-motor reproduction. It seems not to have been much used as a memory method. It has two disadvantages: (1) its report must always be inadequate and (2) involve other organs than the

[1] *Cf.* B. Bourdon (*Rev. philos.*, XXXVI, 630): "reconnaissance est une sorte de *sentiment*."

[2] The effectiveness of mood in memory has recently been remarked by R. MacDougal (*Psych. Rev.*, V, 463), who contends that music at times creates a mood which, once instituted, attracts appropriate imagery.

ones receiving a memory stimulus. On the other hand it has a decided advantage where complex stimuli are used and direct 'reproduction' is impossible. As Binet suggests, it might be used to test the accuracy of memory for past events which were not at the time of their occurrence translated into verbal terms. Description is the memory method of every-day life, but has not yet commended itself to the experimental psychologist. A phase of 'reproduction' quite analogous to the method of description, and identical with it in principle, is the representation of a visual stimulus through the hand, *i. e.*, a form drawn, or a color painted or mixed in solution, or again, a visual length reproduced on paper.[1] The constant errors in all these cases demand special attention.[2]

We shall attempt to show (Chap. III) that a complete catalogue of methods must take into account the presence or absence of the memory image, a condition which the current methods imply but do not usually fulfill.

Reference to the more important experimental contributions to memory reveals a general tendency to emphasize memory as power of retention. This power has, of course, no direct organic expression; hence it can only be inferred from reproduced or recognized contents. Retention becomes a capacity measured in one of these two ways. The important work of Ebbinghaus, which has served as model for numerous later inquiries, takes up the problem, *How much is retained under given conditions?* He finds, *e. g.*, that, other things being equal, retention is a function of time elapsed. There is little to indicate what the memory consists in—what a cross section of memory contents would show; whether the presentation is carried over, modified or unmodified, by memory, or replaced

[1] Work similar to this is suggested by J. McK. Cattell (*Science*, N. S. II, 761) and repeated by F. E. Bolton (*Psych. Rev.*, III, 286) and Franz and Houston (*Psych. Rev.*, III, 531). Dates, events, distances, weights, forms, etc., were recollected by their pupils and put down on paper. The records show a confusion of observation and retention capacities and have little value as memory results. Thus, *e. g.*, the members of a class were asked to indicate the time taken to walk some familiar distance. The result is not primarily a memory result at all, since it does not show what the several individuals knew and remembered, but only an estimate (from various data) of something which they did not know directly. This fact, of course, does not bias their anthropometrical application, which Cattell indicates.

[2] A case in point is the work of H. K. Wolfe, on "The Memory for size of familiar objects" (*Psych. Rev.*, January, 1898). Wolfe found that some familiar objects, as bank notes, were under estimated when drawn in outline on paper. Plainly this fact does not necessarily report the visual image of the note, since reproduction might easily be biased by the introduction of alien senses, *i. e.*, pressure, muscular exertion, etc. In fact, by different methods, Baldwin (*loc. cit.*) finds that square size is *over estimated* in memory.

by wholly different contents subserving retention. Wolfe, indeed, criticised Ebbinghaus's method as involving too complex conditions; but his own results are the same in kind, *i. e.*, they register the capacity for retention—in this case for tones. Recognition, he asserts, is mediated by a comparison of a tone heard with the image of one remembered, as we have seen. The possibility of other operations in the memory, he does not consider. Still, the material used—tones with small pitch-differences—is probably the simplest available. It cannot be said that Lehmann's work deals primarily with memory. He uses Wolfe's method to ascertain the form of associative connection in recognition.

Beside the capacity for retention of nonsense syllables (Ebbinghaus, Müller and Schumann, and Jacobs), and of tones (Wolfe, Hirschberg and Courtier), we have similar results for retention of letters (Cohn and Smith, W. G.), time interval (Paneth), visual length (Weber, Binet and Henri, Vaschide and Münsterberg), visual size (Baldwin and Wolfe), digits (Bolton, Münsterberg, and Binet and Henri), extent and direction of movement (Münsterberg, Schneider, Smith, T. L., Beaunis and Bowditch), lifted weights (Weber, Wolfe, Landau and Müller and Schumann), tactual space perceptions (Barth and Loewenton), colors and brightnesses (Lehmann and Münsterberg), noises (Schumann), letters and words (Bourdon), and odors (Lehmann).

We intimated above (p. 4) that the course of the work pursued in memory is largely explicable if we take account of popular and traditional conceptions of memory which psychology seeks to make coherent and definite. The case has many analogues in the history of science and philosophy; learning finds its problems ready-made in the medium of common thought. In the instance before us, memory has an obvious importance for mankind. The power to retain and revive experiences is continually put to the test. It is not surprising, therefore, that we find this aspect dwelt upon in popular reflections upon the human mind,[1] and the rise of experimental methods naturally lays emphasis upon the *quantitative* statement of memory's capacity.

Again, the value of much of the work of this kind for practice is apparent. Education gains by any careful inquiry into the human mind. To see science pressed by practice for contributions to utilitarian ends is not unusual. The natural sciences and their corresponding arts afford many

[1] One seems to see a direct connection between the loose ends which experience brings to reflection upon mental phenomena and the generation of a 'faculty psychology' which conceives the mind as a bundle of powers, or capacities for practical activities.

instances of this; medicine, *e. g.*, gathers tribute from physiological estimates of bodily function. A similar levy is laid upon psychology by pedagogy. The *practical* bearings of the facts of habit, attention, memory and apperception explain the drift of much material collected upon these aspects of mind. Reference to systematic works on pedagogics shows, on the one hand, the assumed importance of these rubrics for the art of teaching, and, on the other, their dependence upon psychology.

It is, nevertheless, clear that the quantitative aspects of memory and attention do not exhaust them for psychology. Consider memory. So far as we have looked into the literature, analysis has been seen to play a minor part. The contributions to the subject have measured the volume of the stream and the pressure at given points, to a neglect of the contents. Conventional terms have, in many cases, been substituted for analytic work. One step in advance has indeed been made A general 'faculty' of memory has been resolved into a plurality of memories. Mental pathology, nerve physiology, and psychological experiment have brought about this advance. Some attempt has also been made to ascertain the dependencies of one sense-memory upon another; *e. g.*, Cohn attempts to control the acoustic-motor and visual memories and to show the effect of their combination and isolation. Whitehead and Smith, T. L., have made similar attempts, and Binet compares two extraordinary memories, one a marked visual, and the other an auditory type. Galton goes still further and makes independent exploration into the capacity for visual imagery among various classes of individuals (*Inquiries into Human Faculty*, pp. 83 ff.).

The work which we propose to outline in the following chapters is directed primarily to the analytic side of memory;[1] to

[1] It remains to be said that Dr. Kennedy (*op. cit.*) has already pointed out the lack of analytic work in memory investigations and has urged its importance. There are, however, two or three places in his treatment of memory problems in which we disagree with this writer. These seem important enough to mention. They are the following: (a) 'Recognition,' he says, is distinguished from 'reproduction' only by the "expression on the part of the reagent of the state of the condition of the memory:" *i. e.*, by the memorial report. Plainly, there is a failure here to distinguish between 'direct' and 'indirect' sensible discrimination; between the experience and the report of the experience. When the writer makes every experiment on memory fall into two parts: A, the stimulus, the thing to be remembered, and B, the report (478), he leaves out just the important factor, namely, the psychological experience. This he does bring in later as the image, which he makes essential to any memory (485), but he does not recognize its importance for method. In our view (1) method properly turns on the *psychological* factor, and here (2) we may, or we may not, have a memory image, as we have before indicated. (b) Our experience con-

the contents of the memory consciousness, and more particularly to the part played by the memorial image. The following chapter will consider the image in its genetic and functional connections as a preface to the experimental inquiries into its nature and fidelity.

CHAPTER II.

The Genesis and Function of the Memory Image.

The term 'Image' has a wide significance in Psychology. Its original close connection with vision—the retinal picture or image—is apparent. The use of 'image' as 'retinal picture' is moreover not wholly technical; the word has a like significance in every-day life. The image is the copy of the *real* in ordinary speech; the eye, like a mirror, reflects, reduplicates 'the world.' It is then but a step to the image as a picture of the memory. "The face is graven on my memory," we say, as if it were an intaglio cut in stone.[1]

The language of psychology has extended the term memory image from its connection with vision to various mental contents which represent a definite past event, without regard to the sense affiliations which the contents may reveal. Psychology has also added to the nomenclature of imagery the terms 'positive after-image,' 'negative after-image,' 'memory after-image,' phantoms of sensory memory, hallucinations and illusions. Fechner was the first to complete the list and to give a

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tradicts Dr. Kennedy's distinction of (1) "immediate" (simple) and (2) "mediate" (complex) memory materials; *i. e.*, we are said to remember a thing (1) directly, "as it appeared in reality," or (2) "by means of concepts." We do not find that a thing is remembered "mediately," "conceptually," by "classification," when or because it is complex: one's memory of a man or a house *may* be direct, may be simply a visual image or, on the other hand, one's memory of a simple visual quality, *e. g.*, a red, may be indirect, mediate, *i. e.*, through a word; nor should we call Ebbinghaus's material necessarily "conceptual" (as the writer does) but simply complex and variable: it involves several memories, but not necessarily classifications. An eye-ear-memory *may* be direct and immediate. We agree that these pioneer experiments give us functional rather than structural, existential, analytic results. (c) We take issue with the statement that the incentives to memorial transformations are always unconscious (490). In Chapter III, we bring a case in which the conscious filling of the memory interval affects the fidelity of the memory.

[1] There is an evident influence of this trope on the creation of the 'idea' in Humian psychology. *Apropos* of this, A. Frazer (*Amer. Jour. of Psych.*, IV, pp. 230, ff.) has called attention to the important influence of visualization on the construction of the psychologies of Hobbes, Locke, Berkeley and Hume. He concludes that 'idea' for these men connoted the visual image of the memory.

full description of these phenomena. They differ mainly, on the physiological side, in a more or less remote connection with excitation of the sense organs. Positive and negative after-images receive due attention in connection with theories of vision; abnormalities of the imaging capacity, as phantoms, hallucinations and illusions come under the direct care of the mental pathologist;[1] the memory after-image seems to be a special case under memory images proper, whose scanty literature calls for new investigations.

As the psychology of sensation and perception comes before the treatment of the more involved data of mind, so memory must be reduced to its lowest terms before its contents will easily submit to analysis. There is consolation here, as elsewhere, in working among the more elementary processes: the beginning may be more than a beginning, for the simple is sure to betray something of the nature of the complex, and thus the full analysis of the latter the more quickly follows. Psychology has often been asked to justify herself against the charge that she analyzes out 'mind' and only juggles with the inert remnants; but she is firm in the belief that careful analysis is the one initial procedure with complex processes whose outcome the history of science guarantees. The problem of the fidelity of the image is peculiarly dependent upon simple contents which are unequivocally related to definite peripheral excitations, since the character of the image is ascertained by its comparison with an external stimulus. In other words, we face a psychological problem on the assumption of a definite relation between stimulus and sensation. The uniqueness of the problem consists in the fact that a peripherally aroused sensation is here compared with one centrally aroused, instead of with another peripheral sensation.[2]

Before proceeding with an account of special investigation two preliminary questions confront us: (1) the relation of the memory image to perception, and (2) the function of the image in the life of the organism.

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[1] As Burnham points out (*Amer. Jour. of Psych.*, II, p. 456) there is close connection between the normal phenomena of memory and its pathological manifestations. It is not essential for our purpose, however, to discuss the pathological side of memory. The literature, though recent, is already bulky. But a theory of the image and its physiological substrate has to look very carefully not only into the direct disturbances of memory but also into the interferences in perception caused by various forms of aphasia.

[2] The terms "peripherally" and "centrally aroused sensations" are, of course, not to be confounded with Spencer's classification of sensations and emotions into "peripherally" and "centrally initiated feelings."

(1) It is quite evident that all developed[1] perception involves the past experience of the individual.[2] It is equally evident that not all perception involves a memory image. Where the image appears we have to determine.

The attempt has been made to base perception upon association aroused by external stimulation. Spencer, *e. g.*, includes under association the assimilation of past experiences to a new one of a similar kind (*l. c.*). Now it may well be that every central excitation leaves its record (in what way we do not know) in the brain, at least for a time, but this is quite different from the assumption that past events necessarily appear in consciousness, according to associational or other laws, when a similar present event occurs. Exploration of the perceptive consciousness, at least, fails to return evidence of such appearances, except under certain rather exceptional conditions. It is conceded, of course, that a perception is often a direct incentive to the arousal of memory images, but it is not clear that the perception is conditioned upon such arousal. Even recognition, which is psychologically a degree more complex than mere perception (or cognition, as it is often termed in distinction from recognition), need not involve 'reproduction,' as we have tried to show. Whether direct recognition be referred to a "quality of knownness" (Hoeffding), or to a unique feeling of recognition (Bourdon and Washburn), or to a "fringe of tendency" (James, *Psych.* II, 674), or is further analyzed into a mood, *plus* the power to excite central areas[3]

[1] Memory as a function of organic matter would figure in all instinctive and habituated response to stimulation; but we are not here concerned with this conception of memory (*cf.* Hering: "Memory as a Function of Organic Matter").

[2] Wundt says (*H. & A. Psych.*, p. 347, trans.): "Memory of some kind is involved in the cognition of an impression; memory of a definite kind in its recognition."

[3] The meaning of Kuelpe's phrase "in der besonderen central erregenden Wirksamkeit" (p. 178) is a little doubtful. It can hardly mean that an object is known because of a potentiality to attract excitation at the center (*cf.* Hoeffding's *Vorstellungs-potentialität*). The 'knownness' must be paralleled by some aspect of central excitation itself and not by a mere capacity. Perhaps the 'effectiveness' consists in an incipient re-excitation of certain centers. This is supported by the sentence a little further on (p. 178): "zu specielleren Urtheilen pflegt es bei diesem unmittelbaren Wiedererkennen nicht zu kommen, gewöhnlich wird bloss der Name 'bekannt' sofort reproducirt." We need not, however, assume, as Dr. Washburn seems to demand (*l. c.*, p. 270), that, the word 'known' is mediately reproduced through precedent conscious processes. It is conceivably sufficient that the repeated stimulus may itself immediately call up the word. It is not, however, our experience that *any* verbal impulse necessarily attaches to the 'familiar.' It seems to be often replaced by a general psychophysical attitude towards the known object. It is difficult to make this more explicit, but very probably the attitude is to be explained

(Kuelpe), the necessity of reproduction may be avoided. If reproduction is still urged in the form of 'dark images' (Wundt, Hoeffding and Lehmann), which introspection does not reveal, the *onus probandi* seems to fall on those who press the hypothesis of effective subconscious imagery.

No stimulus to sensation comes as entirely new to the organism: in other words, every *conscious* excitation, at least, awakens some reaction. From the side of consciousness, this means that everything goes together somehow in the individual's experience, *i. e.*, has a meaning; from the side of general nervous functioning we may say that every excitation that reaches the cortical centers disturbs a definite cortical area. The extent and nature of the excitation condition the resulting consciousness. The meaning involved we call cognition, recognition, train of thought, logical thought, etc. Now the place where the memory image appears, and the part it plays in contributing to meaning, are important. If we were to give a progressive series of the simpler types of meaning it would run something like this:[1]

I. Cognition or simple perception. No associations necessary. A minimum of meaning. (Wundt calls this assimilation, or simultaneous association, *i. e.*, fusion of sense impression and memory image, *plus* feeling of cognition; Spencer, association.) No image discoverable through introspection.

II. Recognition. A. Direct. i. Without interest. Taken-for-granted stage. Well-worn environment. A general feeling of comfort and security. Approaches *I.* No image.

ii. With interest (active or passive attention): object stands out from environment. Only association is verbal 'known,' which may be replaced by motor impulses. (Hoeffding finds 'quality of knownness;' Lehmann and Wundt, 'dark images;' Kuelpe, a mood *plus* tendency to central excitation; Ward, an assimilation process; Washburn, an unanalyzable feeling of recognition.) No image.

iii. Enforced (extrinsic) interest (active attention), *e. g.*, simple recognition under experimental conditions. Judgments 'like' and 'different' follow. Image not necessary.

iiii. Direct Recall: Memory in the narrow sense (Bradley, v. infra); 'pure' memory (Bergson, v. infra). A definite past, with subordination or exclusion of the present. Image essential.

B. Mediate. i. Through auxiliary ideas or other motives to recognition; *e. g.*, person recognized from description. May be image.

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by definite impulses to movement. Since familiarity differs in degree rather than in kind, the same motor reaction would be interpreted as object-known for a great variety of stimuli.

[1] This, of course, is not, in any sense, a genetic scheme.

ii. Conscious comparison of object and image. Image necessary.

This classification, though tentative, may serve to indicate the direction of increasing complexity of meaning which the simpler processes—those closely allied to sensory stimulation—exhibit. No hard and fast lines can be drawn between the various rubrics, and this indicates the continuity of the series.

The classification suggested will be further substantiated if we find that it agrees with the rationale of the development of the memory image. This brings us to our second point, and we have to ask what is the genetic significance of the image.

(2) If we take the biological point of view, it seems altogether probable that the memory image was a comparatively late acquirement for the organism. A command of consciousness through active attention, that should abstract from the pressure of the immediate environment and hold an isolated sensation-complex, aroused by central excitation, is the prerequisite of the image. A highly complex nervous apparatus seems necessarily involved.[1] The primary use of the image, we surmise, was to carry the organism beyond the limits of the immediate environment and to assist it in foreseeing and providing for the 'future.' Its function seems, then, to have been a prophetic one; it was a means to what we may term *remote adaptation*. The capacity to image is a prerequisite for a future. The extension of temporal and spatial relations has been immensely facilitated by excursions of consciousness beyond direct perception. In fact, the past and the possible (the not-yet), essentials for a developed time consciousness,[2] must have waited upon the power to abstract from the present. The mere presence of an image does not, of course, explain the complete elaboration of times. But when once the capacity for independent imagery has been acquired, the stress of existence will inform the image with significance.

The significance will, undoubtedly, be vague for a time. The image will mean a situation which does not belong to the one immediately presented; its temporal situation will still be

[1] The contention that some of the higher animals, *e. g.*, dogs, dream, does not seem improbable if we consider dreaming as one of the earliest—perhaps the earliest—appearance of the image. Oblivion to external stimulus might well be the prime condition for full consciousness of events not connected with perception. The pressure of the senses during waking life makes a practical demand on the attention which leaves little chance for central excitation to hold consciousness in its full right. It is indeed only at a comparatively adult stage that man performs the feat of total abstraction from the present.

[2] We do not, of course, mean mere temporal succession, which exists long before the differentiation of times past, present and future. *Cf.* Stern: Die psychische Präzenzzeit. *Zeitsch. für Psych.*, XIII, 325.

unfixed. Later, its extreme importance will attract the attention, and thus it will be reacted upon. As an element in action, it will become more and more teleological; it will become the headlight of consciousness, pointing before to an experience which is to follow, and which must be provided against. Thus two things are important in determining its setting: (1) it must be joined with the motor mechanism, and (2) it must be found to be a term x in a series starting from a present a; *i. e.*, it must be brought, in a twofold way, into connection with immediate perception.

The past, being less important than the future, must have been known, as such, later. Still, the future having been once created through the pressure for survival, the past would soon follow. A different connection with the present, would change the tense. Strangely enough, the past seems to have been more the fruit of leisure and idleness than the future. There is an instructive analogy among the earlier forms of civilization, where the historian is a much less important personage than the prophet, the soothsayer and the seer. Even for us the function of history is apt to be rather oracular than reminiscent.

Thus the general function of the image is analogous to binocular vision and binaural audition. The image does for temporal orientation what two eyes and two ears do for space perception. It adds perspective in time; these provide perspective in space. The former gives the distant in time from 'now;' the latter the distant in space from 'here.'

The necessities of life, however, must have demanded a suitable reaction upon environment long before images appeared. Wundt contends that the definite reaction upon food stimulus seen in the lower forms of life is to be explained "on the assumption that inherited organization determines the correlation of pleasurably toned sensations with certain sense-impressions, and that these sensations are connected with the movements subserving nutrition" (*H. & A. Psych.*, p. 348, trans.). This consciousness he calls cognition. Even recognition, which Wundt connects with "memory of a definite kind" (*op. cit.*, p. 347) and ascribes to the higher animals, might precede the power for independent images. This is borne out by the well-known fact that recognition is often possible when 'reproduction' fails. This accounts for our confidence when we say, *e. g.*, "I don't recall his face, but I should know him if I saw him." Similarly, in learning a language, many words absolutely refuse to be recalled which are recognized on sight. It is a doubtful explanation to say that the sight of the word is only a better incentive to its recall than is otherwise obtainable. How can it be an incentive until the word is first known and

its meaning adumbrated? And after the word is known, what is the need of an incentive? Again, Galton says (*Inquiries*, p. 97): "the visualizing and the identifying (recognitive) powers are by no means necessarily combined." And Ward points out (Art. "Assimilation and Association." *Mind*, N. S. II and III) that assimilation is prior to association and quite distinct from it. He argues that true memory is not involved in the former process, but arises only through association, which presupposes the connection of A and B by apperception in order to a recovery of the memory *b* through the recurrence of A. He holds that such apperceptive connection could appear only at a late stage of development. F. H. Bradley, in a recent article on Memory and Inference (*Mind*, Apl., 1899, pp. 145 ff.), remarks that "to know the past or future as such is a hard and late achievement of the mind, for it implies an enormous degradation of the present. . . . . Past and future do not and cannot exist for us until reality appears as a series in which the present has sunk and has become but one member among others." He continues by affirming that the emergence of a past and a future marks the line between the animal and the human mind.[1] The animal has "no world sundered from the world of its immediate practical interest, and to take an immediate practical interest in the past as past is surely not possible." (1) Like most attempts at fixing landmarks in genetic psychology, Mr. Bradley's is balked by too great preciseness. Lacking very definite data, psychology will hardly be satisfied at this day by a proposal to set off sharply the human from the animal mind by any broad functional activity, such as 'reason' or 'memory.' In this case it seems better to leave—until the *experimentum crucis* is made—the advent of the image more indeterminate, but to insist on its recentness. (2) As to the impossibility of an animal's "practical interest in the past," we repeat our suggestion that it is adaptation which attracts the first practical interest in the image. That the image should stand out *at all* from the 'present,' may, in part, be laid to the incompatibility of the 'perception' and the 'image,' as Mr. Bradley suggests.[2] But it is possible, also, that the image, considered apart from its proper function, as simply conscious event, may be quite different in quality from those sense impressions which mean for the animal immediate or present

[1] This line of demarcation was also suggested in 1886 by Ch. Richet; *Rev. philos.*, XXI, 587.

[2] Mr. Bradley's account of the genesis of memory seems to us to fail because it leaves out of regard feeling and volition. It is pre-eminently true of the simple mind that it learns by doing. No abstract consideration of associational series of ideas will account adequately for the development and extension of consciousness.

'reality.' May not the close relation between peripherally and centrally excited sensations be explained by similarity of function? A book before me now and remembered from yesterday is one book, whether perceived or imaged. The perception and the image mean for me one and the same object. But if we grant a qualitative difference[1] between them, we have an argument to add to Mr. Bradley's argument from incompatibility.

There is to be noted in this connection a recent monograph by E. L. Thorndike, on "Animal Intelligence." On the basis of experiments with cats, dogs and chicks, the author concludes that these animals are devoid of 'reason,' inference, and comparison, but are capable of forming associations; not associations of ideas, necessarily, but associations of sense impressions with impulses to activity. He finds no proof of the existence of 'free ideas,' 'representations,' or 'memory images,' and raises a doubt whether these appear at this level of animal intelligence. If representations are already present, he maintains that they are confined to specific and narrow practical lines and are revived on "the spur of immediate practical advantage" (as in obtaining food), *i. e.*, they serve primarily as means to previsory adaptation.

The late appearance of 'representations' is again supported by Bethe's work on ants and bees (Pflüger's Archiv, LXX, p. 15). This author makes the mistake of assuming a memory image as a *sine qua non* for recognition. However, he finds no evidence of recognition of any sort in his insects, and even intimates that consciousness may be entirely lacking to all invertebrates.

These two monographs, and a few others of the same tenor,

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[1] There seems to us to be some introspective evidence for this qualitative difference; this above the vast differences in intensive, spatial and temporal characteristics. Kuelpe, who has taken up the analysis of imagery where Fechner left it off, emphasizes the latter discrepancies and, though he holds to a qualitative likeness, admits that this is only an *apparent* likeness, *i. e.*, "a relation of contents in which they [centrally and peripherally excited sensations] evoke the same judgment." We are inclined to go further, and to say that the two when considered apart from the "judgments which they evoke" possess quite different qualitative systems. The fact that experience demands a superposition of the two systems explains their apparent likeness and also the occasional confusion of perception and memory. It is moreover conceivable that the different nervous elements, central and peripheral, involved in the two cases should occasion a qualitative difference in consciousness. [*Cf.* H. Ebbinghaus's distinction (*Grundzüge der Psych.*, I, 167) between *Empfindung* and *Vorstellung*. Unfortunately, we have so far (erster Halbband) only the author's bare classification of mental elements, and do not yet know the precise import of this distinction].

are infusing a healthy tone of scepticism into comparative psychology. They make the very recent appearance of the more complex processes—inference, 'reason,' free ideas, images of the memory—exceedingly probable.

Contact with surroundings, harmful and advantageous, must have called for early recognition, as we have indicated. Well-known stimuli would bring pleasure or pain, and hence would be courted or avoided;[1] new stimuli would be generally avoided. As the unexperienced had not been necessary for life, the organism could afford to shun the new. Thus cognition or simple recognition would govern reaction toward the immediate environment, and only a later and more complex stage would demand conscious previsory adaptation.[2] This stage would be the longer delayed because instinctive reactions are reinforced among some of the higher animals by a motor habit, set up through the individual's experience, which seems to mediate recognition without the addition of memory images. M. Bergson (*Rev. philos.*, XLI, 225 and 380) has laid stress on this

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[1] The statement that the familiar is pleasant plainly needs limitation. The fact that the baneful as well as the useful recurs constantly in the individual's life is sufficient to guarantee that not all 'acquaintances' will be 'friends.'

[2] A genetic account of memory radically different from the one in the text is given by Professor J. M. Baldwin in *Mental Development in the Child and the Race*. Imageful memory is here accredited to most submammalian forms, but true recognition only to a very late period of development (pp. 319 f.). In the earlier, "simple memory" type are lacking "the finer motor, synthetic adjustments of the attention which by their variations constitute recognition." To us, the isolation of the image has seemed the difficult feat for consciousness, involving a nice control of the attention; while the 'familiarity' attaching to recognition was much the same for all such contents, and was easily provided for by a ready reception into the total consciousness and the peculiar motor reactions set into operation.

It is to be noted that the author has also called attention to the relation of the image to adaptation: he says (p. 319), "creatures which have in them the faculty of anticipating experiences, both pleasurable and painful, by the recall of memory pictures in something of the original setting, and which can, in consequence, anticipate the actual experiences to secure or avoid them by an adapted reaction, are most fit for natural selection." Our criticism of this position has been that the image, as simply a sensation aroused directly in the central organ, *may* assume one of several functions, anticipatory, memorial, imaginative or schematic. The storm and stress of existence point to this order as the natural one: anticipation, especially, seems the most elementary function of imagery, and not a mental product recast from the mould of pure memory.

Another explanation of the efficiency of memory images in aiding adaptation regards these as "idées forces," and demands that they be considered along with the physiological mechanics of memory. See Alf. Fouillée; "La survivance et la sélection des idées dans la mémoire;" *Rev. des deux mondes*, 1885, May–June, p. 359, and elsewhere.

type of motor memory, and gives as illustrations the dog's 'recognition' of his returned master, and with us the learning of a thing 'by heart.' This memory he sets over against imageful or 'pure' memory, whose rise he places at a later date. Whether or not an animal's definite and peculiar reaction to his master can justly be termed recognition in the usual sense, it seems much easier to err in ascribing it to the power of recollection *through images* than in limiting it to obvious motor concomitants *plus* strongly toned feelings. It seems, then, a useless abrogation of the law of parsimony to attribute to most of the lower forms of animal consciousness a power of abstraction sufficient to image the past or the future. If utility explains the existence of the image, as intimated above, one sees the close connection between memory and imagination. So long as a rough-and-ready attitude toward the world suffices for survival, images will not appear. It will only be after the non-present has been thrown up against the background of perception that its contents will be conceived as possibility, and then as warning,—and thence the way to prophetic adaptation is short.[1] Instinct aroused by 'familiar' stimuli comes to be superseded by conscious prevision. This prevision, though closely allied to imagination, is not to be confused with it. It is expectation, rather than imagination. In expectation, the image is set over against the present: in imagination, it drives out and supersedes it.

The acquirement of language, spoken and written, has made an essential change in the modes of memory. Visual and auditory images of things have been, through it, largely replaced by verbal memories. Written language, especially, has relieved imageful memory of a great burden. Traditions of the tribe handed down for generations are supplanted by histories: descriptive writings take the place of camp-fire narration. Language improves on images of the memory because it stereotypes. Among civilized peoples, old memory types persist but are of small value, in general. Indeed, few people are conscious of the memory type which they represent, although linguistic memory preserves the preference for visual, auditory or motor retention. The reduction of adaptation to a set of rules destroys largely the necessity for encasing the past in images kept for reference in preparing for future needs.

Still, the memory image has not entirely lost its function.

[1] An intermediate stage in this process is furnished by the memory after-image, which is immediately dependent on its peripheral excitation, and soon vanishes, but is a step toward the differentiation of the present from the non-present. For the time-limits of the memory after-image under distraction, see A. H. Daniels (*Amer. Journal of Psy.*, VI, p. 558).

Retention through the centers for vision, audition and movement often leads to imagery. Language, because of its fixity, requires to be supplemented by images which hold the concrete event for future use. Galton (*op. cit.*) makes some interesting observations on this point. He finds the visual imaging power very great in young children and in some wild races as, *e. g.*, the Bushmen and Eskimos, and remarks that "language and book-learning certainly tend to dull it," and that "our bookish and wordy education tends to repress this valuable gift of nature." He speaks of the French as facile visualizers and says: "the peculiar ability they show in prearranging ceremonials and fêtes of all kinds, and their undoubted genius for tactics and strategy, show that they are able to foresee effects with unusual clearness." He finds that "the faculty is undoubtedly useful in a high degree to inventive mechanicians, and the great majority whom I have questioned," he says, "have spoken of their powers as very considerable." And again: "a visual image is the most perfect form of mental representation whereever the shape, position and relations of objects in space, are concerned. It is of importance in every handicraft or profession where design is required. The best workmen are those who visualize the whole of what they propose to do before they take a tool in their hands." Galton does not distinguish sharply between the faithful memory image and the image of phantasy. His illustrations show how the former merges into the latter. Indeed he says (p. 173): "recollections need not be combined like mosaic work: they may be blended on the principle of composite portraiture. I suspect that the phantasmagoria may be in some part due to blended memories."

The whole realm of literature and fine arts, so far as it is the creation of phantasy, shows the memory image at sport; the phantasy stands to the reproductive image as play to work;[1] and, like these, the memory and phantasy images represent the activity of one and the same function. Memory, continually dropping and picking up its threads and dyeing them anew, weaves the bizarre fabric of the imagination. It takes its cue from utility, and here necessity truly is "the mother of invention." Compelled to utilize experience as a lesson for the future, the imaging tendency survives its most imperative need and loses itself in the vagaries of phantasy.

Briefly, then, our view concerning the lineage of the memory image is as follows. The earliest conscious reaction upon environment was provided by intimate connection of pleasurably-toned sensations with reactions appropriate for nutrition. Such

[1] Quite a different relation from the early prophetic and retrospective imageries.

reactions developed into complex instinctive actions in presence of both pleasurable and unpleasurable perceptions. Next, the distinction between the familiar and the strange (nascent recognition) appeared. As adaptation became too complicated and too delicate to be entrusted either to instinctive control or to response in face of critical stimulation, a discrimination between the present and the non-present arose with the appearance of general images. These images were excited in a variety of ways, and helped to govern action as peripheral stimulation—special and organic sensations—had done before. Special images set in a definite place in the 'future' and the 'past' came later, and mediated adjustment for special occasions. Simply as a part of the past the image has had little value, but as an index of the future its function has been important. With the rise of language, experience became conventionalized, and set rules replaced the less reliable images. These still persist, however, (1) where arrangements and previsions do not permit linguistic statement, and (2) as phantasy images.

CHAPTER III.

Experimental.

It is above all essential, in dealing with memorial imagery, to supply conditions which shall assure the presence of images. As we have before indicated, retention and even recognition do not themselves give such assurance except under certain definite conditions. It will be seen at once that there is a limited range of imagery from which to choose. Images of taste and smell are comparatively rare. Olfactory and gustatory memories usually reduce to peripherally 'reproduced' or to imaged puckers, smacks, swallowings, salivary excitations, inhalations, organic sensations, auxiliary ideas of space and time relations, and feelings. Smell and taste imagery proper is too scanty and too uncertain to turn to account in a preliminary study of imagery. There is an evident biological reason for the paucity of images from these two senses, in civilized man at least. Names, colors, general appearance, etc., have been of more service in the memory than direct images of taste and smell could have been. It is very probable, however, that in primitive conditions these had a much more important function. Haptical images, beside being vague and ill defined, offer peculiar difficulties. There is, in the first place, a strong liability of confusing images of the memory with sensations excited in the terminal organs. The sensory-motor connection is especially strong between muscular and tendinous images and

innervations. A concentration of attention on an imaged movement is pretty certain to become the adequate stimulus to peripherally initiated strain sensations. The difficulty of isolating 'muscular' images is shared by smells and more especially by tastes. Since the adequate stimuli to the last two senses are not definitely known, it often occurs that one is not sure whether one has a *bona fide* image or an actual excitation in the end organ. Of haptical images it may again be said that various factors—pressures, pains, temperatures, strains and joint-pulls —are so indissolubly interwoven that the isolation of any one sense image is well-nigh impossible. To this may be added the fact that skin sensations, because of their functional, external reference, are overgrown with visual associations.

Organic images elude so successfully the usual incentives to reproduction, and are so vague, as to put their employment out of the question.

There remain the two most highly developed special senses—audition and vision. Here we find a wide range of stimulus qualities and intensities, paralleled to some degree by a wealth of memorial imagery. Here, if anywhere, we ought to be able to isolate the image, to study its nature and function, and to determine its qualitative fidelity by close comparison with sensation.[1]

We have chosen visual imagery because it seemed to promise better material for moulding a satisfactory method, and because it delivered us from various technical difficulties which audition presents. We have not attempted much more than an exploration and scrutiny of methods, and a prolusion for subsequent work. We may be allowed to remark that a more systematic investigation than we have been able to make is now in progress in the department of acoustics in this laboratory.

The work with visual images extended over colors and brightnesses.[2] Brightnesses were found to offer the simplest conditions,[3] and were pressed farthest by various methods.

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[1] The inexact distinction 'sensation' and 'image' is employed simply as a matter of convenience. It avoids a long circumlocution, and sets off 'image' from memory in general. Kuelpe's distinction of "peripherally" and "centrally excited sensations" seems the clearest.

[2] Additional experiments on memory for visual form are not yet published.

[3] It hardly need be said that the reason for discussing only images of the various senses is their relative simplicity. Here one has the best opportunity for instituting a direct comparison between an image and its corresponding 'sensation.' As one retreats from sensuous 're-excitations' one gets more and more on the border line between memory and imagination, and into the realm of general mental imagery, that is, into the region where the temporal position of the image be-

Methods. As we have seen, investigations of the memory suggest two principal methods: reproduction and recognition, and two auxiliary ones: comparison and description. Since our work was largely methodological, it seemed best to exploit as many different paths of procedure as possible.

(a) *Description.* The least accurate and the least used experimental method is the method of description. Objects, colors, forms, sounds and events usually admit of verbal description. The experience may either be retained in verbal motor images which are reported directly, or in any of a half-dozen other memories which are translated into descriptive terms for the report. A more primitive and direct mode of description, which lies in the direction of reproduction, is the gesticulatory and mimetic. Here a situation is associated with certain motor reactions, and these reactions when renewed serve to recall the situation to the narrator's audience. As we intimated above (p. 10), naming gives a clumsy classification of experience, inasmuch as the same noun or adjective may cover a variety of slightly different experiences which have not enough individual importance to attract separate names. In other words, the indirect is not adequate to the direct sensible discrimination. Külpe draws attention to this fact when he says that association by similarity may often be reduced to reproduction of a common name. As a case in point, Lehmann observes that the German language has only five common names for grays. This out of seven hundred brightness qualities. The case with tones is analogous. We may say, in general, that when small differences are to be looked for, oral description is impossible.

(b) *Recognition* we have seen to be a fruitful memory method. The caveat that was lodged against it in connection with the work of Lehmann and Wolfe has, however, made us cautious here. If 'reproduction' of an experience through an image is not the only modus for memory, the method of recognition is not likely to disclose the fact. The very fact that recognition and reproduction reveal such different capacities for retention points to the evident truth that the image is not the sole vehicle of memory.

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comes indistinct or altogether lost. The 'mental image,' if it is to be distinguished from images of memory, expectation, and imagination, is properly the image unplaced in time. Such an image is normally the result of many similar experiences; *e. g.*, my image of a pin is, until I develop it, a pin image and nothing more: (*cf.* J. Philippe, *Rev. philos.*, XXII, 2. Thus, much of experience gets its personal, episodal side worn off, and becomes 'common mental property.' Whether an image assumes the function of memory, expectation or imagination, or remains only a 'mental image,' depends, of course, largely on the context, and this is as rich and varied as mind itself.

(c) *Reproduction* by itself is limited in its range of application. In the first place, the reproduction (except in the case of muscular, including verbal motor, sensations) has always to come through another sense department than that to which the image belongs; *e. g.*, color, brightness and form through the hand and arm (mixing and drawing), tones through the throat. The reproduction of visual sensations has the further disadvantage that it takes time, and before completion direct recognition complicates the process. The same objection holds for the method of selection used by Baldwin and by Binet, though as a measure of memory capacity this method has value.

The foregoing criticism of the method of reproduction implies that the method covers indirect S. D. (report), as well as the immediate experience.[1] Taken in this way, it is at once seen how near the method comes to description. If, however, we mean by reproduction merely the unequivocal appearance of an image, we give the word a perfectly definite and legitimate signification. Taken thus, reproduction is quite indispensable to any work on images. It does not, however, give a complete method, and there still remains the task of getting at the image and recording it. This is the psychological problem which was stated in the beginning of the second chapter. The method is completed by a comparison of the image with some carefully chosen stimulus to which it is intimately related. It may be better to avoid entirely the ambiguous word reproduction in this connection, and to substitute the word 'recall,' to indicate that an image has been brought voluntarily into consciousness. The method by which it is educed and compared with a given sensation may then be termed the method of (d) *Recall and Comparison.* It differs from other methods (1) in scrutinizing the actual contents of memory, and (2) in making possible a direct comparison of image and sensation.

Apparatus. The Marbe adjustable color-mixer[2] was used. The mixer is run by an electric motor, and carries two intersecting discs of 11.5 cm. diameter. One of the two sectors is adjustable by means of a rack and pinion behind the disc, moving at right angles to it. The size of the adjustable sector is read off on a scale lying against the toothed rack. The ad-

[1] The distinction here between direct and indirect sensible discrimination might be brought out by the terms 'internal' and 'external reproduction,' or much better by reserving the word 'reproduction' for memory images: for mental processes which possess the function of direct reference to previous experience. The *expressing* of such experiences would then be 'productions,' as drawing, painting; or 'descriptions,' as talking, gesticulating: *i. e.*, either *direct* or *indirect* reports.

[2] For description of the apparatus v. *Centralb. für Physiol.*, VII, 811.

vantage of the arrangement is that one sector can be altered at will during rotation. In this way a continuous change of color is possible or, with a short interval for shifting, two successive stimuli can be given without introducing a space error.

Series I. The observer in our experiments sat before the disc at a distance of 2¼ meters. Exposure was made by lifting a black screen directly in front of the disc. In the first set of experiments the variable sector—60° to 100°—was White, and the other Blue, Red, Green or Black. The brightness or color stimulus r was exposed 5 sec., and after an interval—1 min. or 5 min. (in a few cases some days)—a second stimulus, either r_n (=r) or r_l or r_d, was given; r_l contained 5° more, and r_d 5° less of the white sector than r. We will call the first stimulus N, the second V. Just before the end of the memory interval the subject was asked whether he had a visual image of N. After V was exposed, the usual report, "same" or "different" (*i. e.*, "greater" or "less"), was passed. The object of the recall was to bring the image, if it persisted, into consciousness for comparison with V. Under the head of "images" the record was kept "good," "poor" or "lacking." "Good," as carefully explained to the observer, meant a definite visual image, clear and of a distinct quality, "poor" a vague, confused image, and "lacking" a failure of voluntary imageful recall of N. The experiments were performed in the daylight between 9 and 12 A. M., and a few between 3 and 4.30 P. M. Most of them were done with a clear sky; chance changes of illumination between any N and its V were sufficient cause for throwing out a record. The subjects were asked not to attend to N during the interval, and although no regulated distraction was afforded, introspective confessions indicate that it was not usually adverted to until the query as to the presence of an image was made. The subjects did not read or look at colors (except the very dull gray and buff tones of the room) during the memory interval. Their eyes, however, were kept open.

Four of my colleagues, Drs. Gamble (G) and Pillsbury (P) and Misses Dolson (D) and Burch (B)—all psychologists of some training—assisted as observers. A few results were also got with long intervals from five other students in the department (A., R., S., T., and Ti.).

In the year 1896-7, 600 results were obtained by this method; 500 with 1 min. intervals, 84 with 5 min. intervals, and the remainder with longer times.

In relating the arrangement of stimuli to the reports of the observers, three categories are possible, to wit: (1) objective and subjective agreement (C), *i. e.*, objectively equal stimuli are judged equal, greater greater and less less; (2) a memorial lightening (L), *i. e.*, a V=N is judged "darker," a V lighter

than N is judged "equal" or "darker;" and (3) a memorial darkening (D), *i. e.*, a V=N is judged "lighter," a V darker than N is judged "equal" or "lighter."

It will be seen that every deviation in judgment from stimulus magnitudes is a deviation of *at least* 5° of White. In some cases—as *e. g.*, equal judged darker or lighter—it may be much more. The results do not tell how much.

Table I shows the total results for the various subjects. Initials at the left indicate subjects; L, C, and D the categories above given; and the figures the number of experiments falling under each head.

TABLE I.

	L	C	D	SUM.
B	117	106	33	262
D	17	27	7	51
G	35	51	33	119
P	71	50	31	152
A. R. S. T. & Ti.	11	4	1	16
Total Jdmts.	251	238	111	600

The most striking thing about the Table is the distribution of the L, C, and D cases. There are 13 more L than C cases, and more than twice as many L as D cases. Reducing the footings to per cents. we have:

L	C	D
41.9	39.7	18.4

Or, considering only the 'errors,' we find that 69.5% of these fall to the L side. This may be interpreted to mean that whatever stands in the memory for N has a tendency to change during the interval toward the light; *i. e.*, as compared with V, N becomes "too light" in the memory more often than it remains unchanged, and inclines to the light 2.3 times as often as it does to the dark.[1] Now, since a constant difference ($\Delta=5°$), which was found previously to be near the liminal value for our observers, was used, the results may be brought into a gen-

[1] An analogous case with tones—a rise in pitch through the memory—has been noted by Hirschberg (q. v.). Wolfe (*l. c.*, p. 556) holds that the reverse is true, *i. e.*, that a tone in memory is weakened and therefore lowered in pitch.

eral relation to those gained by the method of right and wrong cases.[1] With this method, if $\frac{r}{n} < 50\%$ there must be a constant error $> \Delta$. If we regard our C column footing (Table I) as giving the number of right cases $(\frac{r}{n})$, we find that its value is not only $< 50\%$, but that it is less than the footing of the L column (*i. e.*, 238 < 251). We may therefore conclude that the constant error connected with the memory of N is considerably greater than the D used, namely 5°. More precisely what the value of the memory "error" is, the method does not, unfortunately, tell us. Even though the method were adequate, the number of cases is not sufficient for a strict interpretation by means of the probability curve.

It will be remarked that the judgments of *G* form an exception to the general tendency indicated by the Table. *G's* C–judgments are more frequent than the L or D ones, and these latter are approximately the same (35 and 33); *i. e.*, her errors are equally distributed in the two directions. Introspective notes made during the experiments, as well as results obtained later, furnish an explanation. *G* visualizes with great difficulty, but makes dexterous use of her verbal memories to cover the deficiency. If we add to this the fact that a large number of her reported images are general, that is, are 'mental' images instead of 'memory' images, we get a clue to the apparent anomaly of her results. Here is a case of what we spoke of earlier as the stereotyping effect of language. Verbal images when quite simple have little temptation to change, and when they do change it is not (except by accident) in a constant direction along a qualitative visual scale. *B* is a very facile visualizer and inclines but little to verbal or descriptive memory. *P* and *D* are fair visualizers and their verbal memories appear but little in the series. Of this we shall say more later.

Returning to the matter of the memory 'error,' we shall see that the tendency toward *L* judgments is also evident if the series is divided up according to stimuli used. See Table II.

The per cents. in the following Table must not, of course, be taken too seriously, since the whole series contains only 600 experiments. Still there is evidently a stronger tendency to lighten in the short-wave half of the spectrum (represented by Blue and Green) than at the Red end. Memory for Gray under these conditions seems to be only better than for Red.

The variable White sector alters, of course, the saturation as well as the illumination of the colors. That the change, due to the memorial factor, is, however, largely one of bright-

[1] The fact that Δ was sometimes omitted and N followed by V=N makes the procedure somewhat irregular. It will not, however, affect the general conclusion that we wish to draw.

TABLE II.

(W=60° to 100°.)

	L	L: SUM.	C	D	SUM.
Blue	90	48.4	68	28	186
Red	51	35.6	59	33	143
Green	45	44.1	29	28	102
Gray	65	38.4	82	22	169
Totals	251		238	111	600

ness is argued by the fact that the percentages under L fall so close together for the pure brightness values (grays) and the mixed values (colors). The exact amount of influence of the two factors could be determined only by a calculation of the brightness valences of the colors used. Spectral values would not apply to our papers; and, since the method does not give a maximal, but only a minimal value for the memorial alteration, the valences would be of little use. We will leave, then, the minor, saturation factor, and concern ourselves only with the bearing of memory on estimations of brightness.

Effect of Length of Memory Interval. Having found that the memory contents (we have still to ask what this includes) changes during the memory interval, we have now to inquire whether the change produced is a function of time elapsed. This inquiry, it is to be noted, differs from the inquiry of Ebbinghaus and others (*v.* Chapter I) into the available *amount* of memory material at any given time; that is to say, the relation of memory to obliviscence.

M. Philippe[1] (*Rev. philos.*, XXII, 5) concludes that "mental images" change in the following ways: (1) by fading, elements are dropped or confused; (2) to new images, but remain clear; and (3) toward a type.[2] This list of possibilities will serve our present purpose.[3] Leaving out the first

[1] The method used follows Binet, and involves the various disadvantages of description.

[2] F. Kennedy (*v. supra*) gives a similar list, *viz.*, fading, quantitative and qualitative change.

[3] J. H. Leuba found a similar thing with brightnesses (*Amer. Jour. of Psych.*, V, 370): dark and light images tend toward a medium value. Concerning his method it is to be remarked that (1) the existence of the image was not assured, (2) the standard stimulus was either always in sight or only called for at irregular intervals, (3) sensory after-

rubric, which presupposes a more complex contents than ours, we may ask if the qualitative change in the memory contents, whether toward a type or not, is a function of the time interval.

The following Table III gives the three classes of judgments by intervals elapsing between N and V.

TABLE III.

INT.	L		C		D		SUM.
1′	196	39.2%	205	41.0%	99	19.8%	500
5′	44	52.4%	29	34.5%	11	13.1%	84
2 days	5	62.5%	2	25.0%	1	12.5%	8
7 days	6	75.0%	2	25.0%	–	——	8
Total	251		238		111		600

The figures indicate that the tendency of the memory to lighten increases with the length of the interval. The results, however, demand further support.

Relation of Judments to Images Reported. As we stated earlier (p. 29), a record of images was kept along with the reports of likeness and difference, the subject attempting each time to bring to mind the proper image of N just before V was presented. The only exception to this was in the case of a few (17) early experiments with B.

The following Table gives the number of total experiments under each head, the number of 'good' images and the sum of 'good' + 'poor' images.

We may conclude from this showing: (1) that it is possible for some time afterward to recall a very simple visual impression by means of a visual image. In our series visual images of some kind were obtained in $\frac{5}{6}$ of all the experiments; (2) that after an interval of 5 minutes imageful recall is better—both for good and poor images—than after one of 1 minute.[1] The longer intervals are scarcely comparable with these be-

images were confessedly disturbing, and (4) the result just spoken of is probably to be referred to stimulation within the memory interval, since one image (if present) held over for several successive intensities. The indication of a general law for sense memory is extremely questionable.

[1] This is not in agreement with Lehmann (*Studien*, V, 153), who concluded that the visual memory image is of little value in recognition after one minute.

TABLE IV.

	L	Rel. of Ims. to Exps.	C	Rel. of Ims. to Exps.	D	Rel. of Ims. to Exps.	SUM.	Rel. of Ims. to Exps.
1′ INT.								
Exps.	196		205		99		500	
Good Ims.	121	61.7	118	57.5	51	51.5	290	58%
All Ims.	169	86.2	166	80.9	80	80.8	415	83%
5′ INT.								
Exps.	44		29		11		84	
Good Ims.	34	77.3	19	65.5	4	36.3	57	68%
All Ims.	37	84.1	26	89.6	8	72.7	71	84½%
2 & 7 DAYS.								
Exps.	11		4		1		16	
Good Ims.	4	36.3	4	100			8	50%
All Ims.	8	72.7	4	100	1	100	13	81%
TOTALS.								
Exps.	251		238		111		600	
Good Ims.	159	63.3	141	59.2	55	49.5	355	59%
All Ims.	214	85.2	196	82.3	89	80.2	499	83%

cause they were used by different observers, less trained and less reliable in their introspective reports. (3) It is to be noted, finally, that the largest percentage of L judgments is accompanied by images both good and poor, the C judgments next, and the D judgment next. That is, not only is there a tendency in the memory to lighten, but the tendency is strongest where the memory is a visual image. It is not, however, apparent that the change of the image is the sole cause for the lack of memorial fidelity. Our introspective evidence which is to follow will perhaps aid us here.

Series II. We observed in connection with the modified Right and Wrong Cases method that since Δ did not always appear it was impossible to calculate the exact amount of the memory error: then, too, the time consumed in the longer intervals makes it difficult to get a sufficient body of results for the application of the law of probability. For these reasons, the following new method was tried. A standard disc[1] (black and white) was presented to the subject 5 secs., and at the close

[1]Apparatus and papers (Zimmermann) used same as in former series.

of the memory interval (1, 2, 3 or 5 mins.) a variable disc 30° lighter or darker than the standard (N ± 30)[1] was presented, and shifted (made darker or lighter) until subjective equality was reached. As before, the attempt to produce a visual image was always made. Our observers were Drs. Gamble (*G*) and Sharp (*S*), Miss Carter (*C*) and Mr. Kairiyama (*K*). All were trained in psychological work.

The following Table gives the results. Set I was done during the fall of '97; Set II the following winter. The first column gives the observers, the second the degrees of white in the standards, and the following columns the degrees of white in the V's III N. The various values for V represent the average of four results.

TABLE V.

	Set I.						Set II.				
	N.	1′	2′	3′	5′		N.	1′	2′	3′	5′
K.	120	122.0	123.7	121.7	137.5	K.	120	124.5	122.2	123.0	118.6
	100	110.0	104.5	108.5	103.0		100	102.5	107.7	———	104.0
C.	120	121.5	123.2	124.5	113.2	C.	120	116.7	120.0	116.5	———
	100	97.2	97.2	102.7	100.2		100	107.0	103.0	97.0	———
G.	120	118.5	131.0	111.7	120.7	G.	120	120.7	122.7	120.0	122.2
	100	92.7	79.7	94.7	101.5		100	87.7	90.7	96.0	91.0
S.	120	118.5	116.5	119.5	125.7	S.	120	121.0	121.0	132.2	———
	100	102.5	101.0	104.0	103.5		100	98.2	103.0	100.0	———

The objective values for N were wholly unknown to the observers, who invariably supposed that several (5 to 8) values were being given. If they had detected that there were but two, their images would have become stereotyped after a few trials, and instead of reviving each time the immediately preceding sensation alone, the whole series would have contributed to the memory stock. This summation process is, in fact, impossible to be rid of entirely, however long the series of stimuli, and may as well be faced wherever qualitative memory work is attempted. In truth, it also appears in various psychophysical measurement methods; for example, in the methods of Average Error and Right and Wrong Cases, where the same stimuli are given over and over again. Two results follow. The first is indicated by Paneth (*sup.*, p. 4), who thinks that a thing may be remembered by its place in a series—by its relation to similar things—rather than in its own right. Now the more often a thing is experienced the more definite does its *locale* become. It is related just so and so to its neighbors. It is a gray (say) which stands in a certain relation to other lighter and darker

[1] The direction alternated.

grays. Even where, in other work, a long series of grays was used, there was a well-marked tendency in some subjects to put an impression immediately under a verbal rubric, or to retain the visual image by setting it directly into a line of grays.[1] The second result of this tendency is to complicate the memory process. The seventh term of a series in which a given stimulus is presented over and over again cannot be taken into the mental economy on just the same basis that the earlier terms are: the repetition itself has caused a bias. It seems to be just this kind of a bias which is at the bottom of various "time errors;" it has never been shown, so far as we know, that these are, or are not, connected with a memory image. It seems altogether probable that a stimulus affects the nervous system differently, even the first and second times, without any reference to an image.[2] This difference may then be simply emphasized, if the stimulus is given over and over again.

The method used in Series II is a compromise between reproduction and recognition. There is 'objective' reproduction—

[1] Cattell and Fullerton (*loc. cit.*, p. 149) make a similar observation.

[2] Kuelpe contends (p. 213) that the direction of the 'time error' with successive stimuli should be constant if the error is due to the weakness of the memory image: but it is not; sometimes the second stimulus seems greater and sometimes less. For example, Fullerton and Cattell found that the second of two successively lifted weights—interval 1 sec.—was over estimated (also Lehmann, Starke and Merkel), while with lights (same interval) the second was underestimated. With larger intervals only the probable and not the constant error is given. No satisfactory explanation is offered. A. J. Hamlin (*Am. Jour. of Psych.*, VIII, p. 53) found a tendency to over estimate the second stimulus when a memory image was present. Wolfe and v. Tschisch agree that tones weaken in memory. Leuba's results have already been noted. A. Wreschner (*Dritter Intern. Cong. für Psychol.*, p. 204, and *Methodol. Beitr. z. psychophys. Messungen*, 1898) calls attention to the memorial factor in the time error and says that (with weights) high intensities weaken in the memory, low intensities are strengthened, and a certain moderate intensity remains unchanged. He notes (*Beiträge*, p. 174) that *fading* of the image does not necessarily mean *diminishing:* a very important distinction. Like Leuba he finds a tendency for the image to approximate a medium intensity; this accounts for both the positive and the negative errors.

W's contention (p. 173) that memory plays different rôles in sensible discrimination (where the first sensation passes over almost immediately into the second), and in longer time-intervals, receives confirmation in our Series III, below, which indicates that different rules hold for short intervals—2″—6″—and for longer ones. We can, at least, say that the longer times afford greater range in memory materials. For the short times (S. D.), it does not seem to us that W. is entirely successful in substituting conscious memory (the image) for the physiological explanations of the time error offered by Fechner (*El. der Psychophysik*, II, p. 142) and by Müller and Schumann (*Pfl. Archiv.*, XLV, pp. 37 ff.). At the same time, he has contributed much toward a definite statement of the complex conditions under which this error appears.

production—inasmuch as the making of the stimulus is done under the subject's eyes. Instead of allowing him to mix his colors or grays, they are made for him. There is recognition, inasmuch as he pronounces on the identity of two impressions. It comes very near Baldwin's method of selection, too, since a series (unbroken in this case) is given and the subject selects the 'right' stimulus. It includes, not only a judgment of likeness, but also several judgments of difference.

For our use, the method has two points to commend it. (1) It shows the range of the memory 'error,' and (2) it gives a definite approach to a given stimulus from two opposite directions, thus improving on ordinary reproduction. On the other hand, its imperfections are not to be slurred. There is introduced, first, a source of error in the rate of change of the gray. The white sector was always adjusted by one person, the experimenter, who controlled his rate by means of metronome beats, thus minimizing constant and accidental errors of speed. A clock-work arrangement for adjusting the white sector was planned but could not be procured in time for use. The expectation error was eliminated and successive contrasts balanced by change of direction ($N \pm 30°$). Expectation would, however, tend to obscure a constant memory error; *e. g.*, a change of $+10°$ W. in the memory would require a movement of $30°+10°$ in one direction and $30°-10°$ in the other, while expectation would tend to reduce the difference. Finally, the employment of the memory image is rendered difficult by the presentation of a long series of V from which to choose. By the time the proper gray is reached, the imaged is obscured, though it was perfectly distinct at the close of the memory interval.

The large mean variation got from our limited number of experiments throws doubt upon the practical value of the method. This was as follows for all intervals:

K, 4.4°; *C*, 6.1°; *G*, 7.5°; *S*, 4.0°.

Thus the *m. v.* in the cases of *C* and *G* exceeds the minimal amount of memory increment (5°) found in Series I.

Individual Differences. Only in the case of *K* is there shown in Series II a constant and decided lightening in the memory. The result is noteworthy. A gray of 120° W. is judged to be equal (after the intervals 1′, 2′, 3′ and 5′) to 123.2°, 123.0°, 122.4° and 128.0° and a gray of 100° W. to 106.2°, 106.1°, 108.5° and 103.5° respectively. This, in face of the levelling tendency of expectation, means a very positive tendency of the memory. It has already been remarked that *G* avoids visual memories. Introspective notes, accompanying the results here considered, confirm this. The grays were often held in memory by a verbal associate: *e. g.*, the observer found herself using the

terms "very dark," "medium dark," "medium," etc. These were used as genera, and several grays lying near together could be brought under each by further verbal qualification. Where an image was present in its own right before the second stimulus came, it was referred to verbal descriptions to test its validity and was judged 'right' or 'wrong.' The observer's capacity for visual images seemed entirely inadequate for the work in hand. These facts afford an explanation for *G's* large *m. v.* and for the lack of constancy in the direction of her errors. The distribution of her errors is very much the same as it is in Series I (*cf.* Table I). Her scheme of names is undoubtedly responsible for the general underestimation of the 100° stimulus (Table V). *G* failed to discover traces of mood[1] in recognition of grays as 'like' or 'different.' There was, at times, a perception of strain, little localized, and of oppression and heat about the chest, when trying to recall, but these phenomena were rather connected with the attention than with recognition or reproduction itself. Finally: an unusual variation in the stimulus, as a purplish or yellowish hue, was emphasized and exaggerated during the interval, doubtless by verbal description.

C is slightly more visual than *G*, but her visual memory does not stand by itself. She reported her images to be patches of gray indefinite in outline. These were placed in front, to her left, or in the back of the head. Images were got by an effort: recollection was accompanied by strains in the back and chest. The strains worked upward and ended in the scalp. Diffused sensations from the trunk were prominent. If the effort produced an image, it was either accepted, or rejected as wrong. Like *G*, the observer used other criteria than visual images for her authoritative memory data. For *G's* verbal memory, *C* substituted freely organic sensations and feelings. She stated that gray cloths had interested her greatly on account of the strong affective tones which they produced. Light grays were extremely pleasant, dark grays unpleasant, some of them even ugly, and medium grays indifferent. The same feelings were produced by the gray discs, though repetition reduced them very much.[2] In the last half of Series II, *C* had seven general rubrics which corresponded to cloths. These 'generic' images it

[1] The circumstances were unfavorable for a "recognitory mood." Our experience is that this appears in complex, visual and aural situations, with a strong practical interest attaching. Smells and tastes, though comparatively simple, are generally rich in affection and are not, for that reason, lacking in mood. Experiment, on the other hand, deadens intrinsic interest and rapidly lessens mood.

[2] Light grays were recalled easiest, dark next, and medium with greatest difficulty. Thus is shown a direct relation between feeling and capacity for reproduction.

was which came up for approval with the effort. They do not depend on verbal associations so much as *G's* images do, but are permanent visual furniture, supported by a mass of associated situations (people met, *e. g.*) and affective coloring.

If we reckon qualitative fidelity of the memory in inverse ratio to the amount of deviation from the memory stimulus = N, we get for *C* and *G*, F_c: F_g = 2:1, *F* standing for fidelity and the figures for the two deviations—6° for *G*, and 3.15° for *C*. It does not need to be added that this is a measure of general functional memory, and not of the visual image. Even as indicating capacity, it would be a doubtful exponent of these memory types, in general, since individuals show such amazing variety in the combination of memories.

S has a more useful visual memory than *C* or *G*, but relies a good deal on verbal descriptions and other secondary criteria: *i. e.*, visual associations. There was detected no trace of mood in connection with her judgments and no organic or general adjuvants. The average deviation of the second from the memory stimulus is 2.92°. The Table (II) shows a slight tendency toward the light.

Leaving the general results, let us select those in which "good images" were reported. These stand in Table VI. K is not included, since practically all of his results fall within the above category (*v. sup.*).

TABLE VI.

SUBJECT.	NO. EXPS.	N	V
C	3	100	109.0
	3	120	129.0
G	8	100	97.7
	9	120	132.0
S	12	100	101.0
	14	120	123.0

The Table explains itself. *G's* one exception is readily understood by what has already been said. Her best images, even, were not much relied upon by herself. There is, however, quite a difference between the 97.7° and the corresponding values in the general Table (V).

There is in connection with Series I and II one further point which seems to us important.

It frequently occurred, with all the observers of both series, that a judgment was given with no hint of a comparison of two stimuli. Even where no active recollection was possible, no

vestige of an image surviving the interval, a decision came like a flash with the giving of the second stimulus.

By much questioning we found that the observer's confidence in the correctness of his decision was quite strong in such cases, but usually he was entirely at sea when asked how he made the judgment. There was no trace of a comparison, no trace of the coupling of sense with memory contents. The expression of sameness or difference seemed on the tongue in the instant, without the vaguest allusion to anything past or absent. Such are the short-cuts of memory! An orderly, logical sequence which one thinks one *ought* to find turns up missing. And it is not to be wondered at: experience has crowded meaning into shorthand strokes of consciousness. The result is hard to decipher. Here, processes are ground together into a matrix: there, processes are dropped out entirely; the product glows with functional aptness, but the original elements are nowhere to be discovered.

It seems as untrue to assert that when I meet my friend, I necessarily compare him with a memory image of him, and pronounce the two the same before I extend my hand, as to affirm that the chicken ratiocinates before he proceeds to devour his worm.

Just what occurs in the apparently simple cases which we have cited, we cannot always say. The work *seems* to have all been done for consciousness, and it has only to believe and to report, to be credulous and to gossip. A certain stimulus, if preceded by a certain other, *sets* the organism in a particular way. It is a refined case of the dog's 'recognition' of his master. We simply react appropriately to the stimulus. Undoubtedly, affections and moods often contribute to meaning, but in such schematic cases as we have referred to, these, even, are often lacking, and we can scarcely find anything left to explain and vindicate a judgment.

Series III. The observation that a cloud passing across the sun in the interval seemed to affect the 'memory error' suggested the possibility that the character of visual stimulation during the memory interval might influence the fidelity of the memory.[1] If this be true, we concluded that it ought to be most marked in our work with those subjects who are preeminently visual. That is, a *visual* memory should be altered by continuous *visual* stimulation, whereas a motor or other memory should not be so altered. To test this, observers were blindfolded during the interval. It was, however, observed at once that this would not do, since the conditions

[1] We have since found the same suggestion made by Dr. Hamlin (*op. cit.*, p. 58).

under which the two successive stimuli were given were not identical. The first stimulus followed daylight, while the second followed darkness. Successive contrast was sure to interfere. To eliminate this difficulty, the observers received stimulation from the window of a dark chamber placed within a larger dark room. As the eyes were entirely cut off from external stimulation before either gray was presented, the conditions courted were obtained.

The arrangement was as follows: the adjustable color-mixer described above was placed behind a black screen having a circular opening cut in its center just large enough to let through the face of the disc. In front of the screen and at angles of 45° with the plane of the disc sat two reflector boxes holding kerosene lamps. The position of the lamps and the boxes was always the same, and the height of the lamp flame was kept constant by measurement. The dark box enclosing the observer faced the screen. The observer placed his head in a wooden mask (2 meters from eyes to screen), adjustable vertically, and at a signal pulled open two sliding doors set on the cylindrical front of the mask. The doors when open exposed the disc to both eyes. They closed in front of the nose by means of an elastic band and moved outward and backward in opening. They were supplied with cords and pulleys to be operated by the experimenter, but it was found to be more convenient for the observer to operate them. The mask served also as a head-rest, this insuring steady gaze and a constant position.

A warning signal was given 2 seconds before the doors were opened. Each exposure lasted 2 seconds.[1] The light intensity used gave at times very faint after-images for about 5 secs., and occasionally for 10 secs., but these were so weak as to be unnoticed except in a very few recorded cases. Eleven intervals between 2 and 60 secs. were used (Table VII). The short times were taken, to indicate more precisely the influence of time on the qualitative fidelity of the image. Instead of producing the image at the close of the interval, the subjects were asked to make every effort to hold it throughout the interval. When an image disappeared, the subject reported "gone," and when it reappeared, "now." These reports and their times of occurrence were recorded for 1,100 experiments—25 for each interval with each of the four observers (*cf.* Series II).

The stimuli used were grays of 60° and 70° white. This difference, like the one in Series I, was about liminal. Other

[1] Other times were tried but were less satisfactory for short intervals. The dependency of the memory image on the duration of the stimulus ought to be investigated.

intensities were given at times, and the observers were always ignorant of the exact number of stimuli used. All agreed that several were given them.

There were four possible orders for presentation: ab (60°–70°), ba, aa and bb; and three possible judgments: "same," "lighter" and "darker." Five trials were carried through all the intervals for each observer in this order: 2″, 60″, 4″, 50″, 6″, 40″, 10″, 30″, 15″, 25″, 20″; then five of a new pattern with this order reversed, *i. e.*, 20″, 25″, 15″, etc. This succession was chosen to distribute the effects of practice and fatigue. Each sitting occupied fifty minutes in the forenoon, usually at nine or ten o'clock.

The results follow: the figures at the top give the intervals and the letters at the left are those used in the earlier Tables. The zero line shows failures to judge, *i. e.*, obliviscence.

TABLE VII.

	2″	4″	6″	10″	15″	20″	25″	30″	40″	50″	60″	TOTALS.
D	19	20	18	28	31	26	26	23	28	29	28	276
C	60	62	65	62	59	59	58	59	60	53	58	655
L	20	17	14	7	7	11	12	13	8	12	10	131
0	1	1	3	3	3	4	4	5	4	6	4	38
	100	100	100	100	100	100	100	100	100	100	100	1100

If it be true that visual stimulation alters in a definite way the central residues of visual sensations, we should expect that a "dark" interval would pull the memory residue toward the dark, whereas a "light" interval would tend to pull the memory residue toward the light.

If we set our totals for Tables I and VII side by side we have the following:

TABLE VIII.

	L	C	D	SUM.
Table I (light Int.)	251	238	111	600
Table VII (dark Int.)	131	655	276	1100
Table I: % of Errors.	69.5	—	30.5	100
Table VII: " " "	32.0	—	68.0	100

That is to say, in the *light*, 69.5% of all errors made show a *lightening* in the memory; in the *dark*, 68% show a *darkening*

in the memory. This confirms our hypothesis that a "stimulated interval" has an effect upon the visual memory.

Concerning the effect of length of interval upon retention we find, in general, (1) that the C values show a slight decrease in the longer intervals; (2) that the D values show a corresponding increase; and (3) that the L values decrease more rapidly than the C values. We notice, therefore, that the memory loses slightly in accuracy as the interval increases from 2″ to 60″, and that the tendency of the memory to darken becomes more pronounced.[1] For the intervals 2″, 4″ and 6″ the number of D and L cases is practically the same. The accuracy of the memory is greater in this series than in Series I and II. Here, only 38.4% of all judgments are error judgments; in Series I, 60.3%; only a rough comparison can be made with Series II. The difference in accuracy is probably partly due to the length of interval, but doubtless the difference in general conditions and the Δ used have something to say.

Images and Individual Differences. The habitual memory modes of our various observers have already been discussed under Series I and II. We found that *K* was strongly visual, *S* less so, while *C* and *G* used visual imagery with difficulty, *G* relying mainly on verbal associates and *C* on organic sensations and feelings. Constant introspective reports during Series III confirm the accuracy of this evaluation. With the emphasis now on the image (reported through the interval) *K* depended entirely on visual residua; *S* more than before; *G's* visual memory was slightly aided; while *C's* habitual modes seem to alter scarcely at all; in fact, these seemed at times to be accentuated.

The distribution of their judgments stands as follows:

TABLE IX.

SUBJECT.	L	C	D	0	SUM.
K	16	173	85	1	275
C	34	191	32	18	275
G	41	152	67	15	275
S	40	139	92	4	275
	131	655	276	38	1100

Each observer showed various fluctuations in the number of

[1] We find nothing to corroborate the periodicity of memory noted by Dr. Wolfe and others. The reappearance and disappearance of the image through the interval seems to be partly a matter of visualizing capacity and partly a matter of attention.

D judgments at different intervals, but these seem to be without special significance (v. p. 43, note).

G had a memory after-image 259 times out of the 275; this began immediately after the first stimulus went, and gradually faded away.[1] In the 8 intervals, 10″—60″, the time of the image was nearly constant. The average duration was 5.8″ with an *m. v.* for the various intervals of only .5.[2] According to the subject's iterations, the images constantly grew darker. Since a true visual memory image rarely came to *G* after the disappearance of the memory after-image, we conclude that the darkening apparent in the results is due to the scanty visual factor, the memory after-image, which the observer was able to command by her best effort.

C's retention in this series was evidently in terms other than visual. The verbal element, as before, played a part and was assisted by the strong feeling tone and organic sensations. The observer herself considered the intensity of certain strain sensations to have adopted the function of memorial retention. The retention times that she reported are evidently due to this, and are not indicative of real visual memory after-images. They stand as follows for the various intervals: 2″, 4″, 6″, 9.2″, 13,″ 14″, 20.4″, 23.2″, 27.5″, 30″, and 31.8″. Occasionally a second "reproduction" was reported in the interval, but this lasted a very few seconds and vanished. Cases of immediate judgment without conscious comparison were exceedingly frequent with this observer. These, we conclude, are to be explained by the psychophysical "set" of the organism, which did duty for a more conventional memory contents. The juxtaposition of this memory representation and the second stimulus was the immediate incentive to the reproduction of the word "same" or "lighter" or "darker" without the emergence in consciousness of a comparison. One cannot emphasize too strongly the tendency of the organism to cut corners, and to avoid logical categories whenever they are superfluous.

K calls for little comment. His visual image was nearly always at hand when the second stimulus was presented. *S* gained somewhat in her visual mechanism; while she was not so typical as *K* she was decidedly visual in her memory. The interference by visual (stereotyped) associates will probably account for the smaller number of her D judgments.

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[1] The difference between sense and memory after-images was insisted upon, and fully understood by the observer. Fechner's distinctions were kept in mind.

[2] Fullerton and Cattell (*Perc. of Small Diff'ces*, p. 149) observe that the memory image with lights seems to last 9 secs. Probably this is the memory after-image proper. A. H. Daniels thinks that the memory after-image lasts less than 15 secs. if the attention is withdrawn.

Subsidiary Methods. I. Recall and Selection. A number—3 or 5—of slightly different colors (papers) were exposed successively by a Jastrow drop apparatus. At the close of the interval (5 or 10 minutes), the observer was asked if he remembered one of the colors (say the second in the series). If he did, a longer series (10 or 12) was presented as before, and he reported when the remembered color appeared. When approximately the same brightness was used throughout the series, no constant direction of change was observable: when, however, a series of brightnesses, *i. e.*, 14 reds, greens or violets running from light to dark, was given to select from, 58 correct selections, 17 too-light, and 6 too-dark were made.

Here again, then, with the light-adapted eye (daylight), the memory grows lighter.

II. Burette Method. The subject looked toward the light through an aqueous solution of a pigment contained in a thin glass jar (width 15 mm., height and length 65 mm.). After an interval, the condition of the image was ascertained and then a weaker or a stronger solution was shown and altered by burette droppings until the subject pronounced the color to be the same as that represented by the image. The color was faded by simply adding water from the burette, and deepened by adding a saturated solution of the pigment. The value of the solution was always known in terms of volume of water and weight of the color-stuff. A screen hid from the observer everything but the solution, which was continually stirred by a glass rod.

III. Direct Production. A color was spread as evenly as possible on heavy white paper, and after an interval (1 or 5 mins.) the observer was allowed (using the same materials) to reproduce the color. The errors due to the method were found to be much larger than the proper 'memory error.' In about half the cases the produced color was lighter and in the other half darker than the memory stimulus. (The two were equated by making them into discs and adding a white sector to one or the other.) The method may be of use where very long memory intervals are involved.

None of these secondary methods proved to be entirely satisfactory, though each promised some tempting advantage. It seemed particularly important at the outset to try direct 'production' and 'reproduction' methods since these appeared to offer the best conditions for the isolation of the image. But after our previous criticism of methods, the partial failure of these auxiliary ones may be explained. We have found, in connection with these, (1) that it is impossible to get a well-graded series in paper colors (outside the discs), (2) that successive contrast must be avoided, (3) that solutions tend to be not

uniform, and introduce too large errors for qualitative memory work, (4) that it is difficult to spread an even surface of color, and (5) that the time and conditions required for 'production' introduce special errors.

We suggest as more ideal stimuli than we have ourselves employed: (1) for colors, a spectrum with a movable narrow slit, and (2) for brightnesses, a constant lamp in a sliding plane with a photometric screen for the projection of rays.[1] These suggestions are made because we have found the examination of qualitative fidelity of simple contents to require more refined and discriminating methods than we at first thought necessary. That is to say, for short times, the amount of change in a constant direction of the memory image is quite small, and can be isolated only by great care and under the most favorable conditions.

CONCLUSION.

After an examination of the memory literature, we have to say that investigations have been, for the most part, directed to memory as the capacity for retention, and to the various factors which condition retention. Reproduction and recognition have been used uncritically and their real basis has often been misconceived. 'Reproduction' not infrequently results from the combination of peripherally excited sensations —special and organic—with a recollected memory core, or simply a word, which may be quite different from the original experience in point of contents. As Professor Kuelpe expresses it (*op. cit.*, p. 190): "Der eigentlich psychologische Vorgang kann daher bei der Erinnerung und bei der Phantasie sehr mannigfaltiger Natur sein, d. h., die Bewusstseinsinhalte, welche als Erinnerungsmotiv gelten oder als Phantasien aufgefasst werden, können ebensowohl ganz verschieden sein, wie die besonderen Urtheile, die ihnen eine solche Bedeutung beilegen." Simple recognition stands much nearer positive or negative identification (expressed by affirmative or negative judgments) than it does to pure memory, and the alleged act of comparison with a memory image is rather a logical formulation, suggested by the judgments 'like' and 'different,' than a psychological statement of fact.

A static as well as a genetic view of mind brings us to the conclusion that the image is a late development, and that its primary function was to prepare the organism for future adjustments. From this standpoint are explicable the partial passage of memory into phantasy, and the weakening of memory fidelity.

[1] *Cf.* Fullerton and Cattell, *op. cit.*, p. 135, and Hess and Pretori, *Archiv für Ophthalmologie*, XL, 4, pp. 1 ff.

The experiments carried on for the special investigation of the visual memory image and its fidelity to an original presentation lead us to the following conclusions.

I. Even as simple a stimulus as a colored or gray disc permits a noteworthy latitude in modes of memory which individual psychology would do well to consider. (1) An observer who is pre-eminently visual may image the color or brightness directly. (2) Names, or verbal descriptions or associates, are not, however, entirely excluded, and become of primary importance where the verbal type of memory is strong and the visual deficient. (3) There is marked evidence of the influence of feeling on memory, wherever the affective reaction of the individual varies within a series. And finally, (4) strain sensations about the head and in the trunk, with, perhaps, general bodily sensations, seem to facilitate retention and recognition in certain cases.

II. Discs—grays and colors—shown and remembered in daylight tend to grow light in the visual memory. This fact was supported by all of our observers but one, who is very deficient in visual images, and confessed that names and verbal associations mediated her memory for the discs.

III. Discs—grays—shown in a dark chamber display a tendency in the visual image to grow dark during an unilluminated interval. No lightening is observed with unilluminated interval.

IV. These last two points (II and III) persuade us that the condition of the retina in respect to stimulation during the memory interval is important for the memory image. Illuminated and unilluminated intervals, where all other conditions are constant, are followed by different judgments with the same memory stimuli. We conclude, therefore, that in all experiments with brightness and color, where a time interval is involved, care should be taken to control the state of the visual organ. It is not improbable that a similar caution would apply to other sense memories. This obvious influence of the periphery upon memory indicates the close connection (perhaps the identification) of the sense and memory centers, in the cortex.[1] It also shows that the memory is not to be regarded as a storehouse of perfectly conserved images, but that the most simple memories are continually exposed to change, and that it is, at times, only

[1] Against this noteworthy influence of sensation upon image we have the indication (*v.* note above, p. 21) of a qualitative difference between the two. These two things do not, at first sight, seem to find explanation in the current theories of central localization. It seems wise, at this juncture, to suspend judgment on the various theories—even Flechsig's separate-centers theory—and to wait for more decisive evidence.

by the combination of various memorial resources that retention is made definite and exact. The value of language in this connection is apparent.

V. The length of memory interval has some influence upon the accuracy of visual memory and the lack of fidelity. From two to six seconds no constant direction of change is shown; memory loses slightly in accuracy from ten to sixty seconds, and the direction of change is constant. The degree of infidelity increases above one minute: it is greater at five minutes, and probably reaches its maximum at a much longer period. The memory image, on the other hand, we find to be more readily producible after five minutes than after one minute.

VI. Images can be called up in a large majority of cases of brightness and color stimulation (499 out of 600—or five-sixths —in one of our series). Where the image is available memory is slightly more accurate. It frequently occurs, however, that recognition is perfectly sure and precise where no recollection through an image is possible.

VII. Where the memory after-image is isolated from the true memory image its average duration is found to be quite constant.

THE PSYCHOLOGY OF HOBBES AND ITS SOURCES.[1]

By V. F. Moore, Ph. B., M. S.

Among the pioneers of English thought in the modern era, the figure of Thomas Hobbes is one of peculiar interest. A clear and vigorous thinker, a man of sturdy and uncompromising mould, he stimulated other minds to challenge as well as to develop the principles he laid down. His influence as conditioning the subsequent development of ethical and political theory is everywhere granted; that he was the founder of English Psychology is, perhaps, not so generally recognized. Certainly we shall not expect to find in Hobbes a complete and perfectly systematized psychology, free from the crudities of pioneer thinking; we shall not forget that the vast field of the physical sciences was, at this period, a newly discovered and as yet, for the most part, unexplored territory. It is the writer's aim, in what follows, to piece together Hobbes' system of psychology from his various works, and to show the connection of his doctrines with prior thought. Our sources are the *Leviathan*, the *De Corpore*, the *De Homine*, and *Human Nature*. All references are to Molesworth's edition of Hobbes' English Works.

Hobbes makes psychology a department of anthropology, or the science of man. Man's nature is the "sum of his natural faculties and powers," and these faculties and powers are further classified as animal and rational, according as they pertain to the body or the mind. (*H. N.* I, 4-5.) Thus, at the start, the subject-matter of psychology is clearly marked off by Hobbes. Psychology deals with man's rational powers in distinction from his bodily powers. The powers of mind are of two sorts, cognitive and motive. The former, which Hobbes terms, also, imaginative or conceptive, is that power by which men get those images or representations of the qualities of external things from which all our knowledge is derived. (*H. N.* I, 7.)

Two points here are worthy of note: and, first, that the attitude of Hobbes is quite strictly non-metaphysical. He is nowhere concerned with the nature of mind as a substance. Sometimes, indeed, he would seem to imply the existence of a substantial

[1] From the Psychological Seminary of Cornell University.

mind, but oftener he merely assumes mind of some sort, and passes on to the consideration of the mental powers. The second point to be noted is that his method is empirical. He intends, he says, "not to take any principle upon trust, but only to put men in mind of what they know already, or may know by their own experience." (*H. N.* I, 2.) He distinguishes two kinds of knowledge,—knowledge of experience, and knowledge of truth, or science. Both have their origin in sense, however; it is a question only of remoteness from that origin. To quote Hobbes himself: "Both are but experience; the former being but the experience of the effects of things that work upon us from without; and the latter experience men have from the proper use of names in language; and all experience being but remembrance, all knowledge is remembrance." (*H. N.* VI, 1.) Hobbes' method then is to consist in a rational interpretation of sense-data, and this method can itself have no other origin than sense. (Cf. *De Corp.* I, 1, 2; I, 6, 1.)

The study of the cognitive powers begins then with an inquiry into the nature of sense. In the *De Corpore* Hobbes approaches the problem by way of physics, a fact which is significant for his psychological theory, and indicative from the start of the mechanical view which shapes his thought. Of all phenomena, he says, the most wonderful is "that some natural bodies have in themselves the patterns almost of all things, and others of none at all." (*De Corp.* IV, 25, 1.) To the explanation of sense as a property of physical bodies to be accounted for by physical laws, he directs his efforts.

It is the "great deception of sense" that color, shape, sound, and other experiences of the sentient subject seem to be qualities in the object; indeed "the contrary must needs appear a great paradox." What is the truth in the matter is stated by Hobbes with the greatest clearness in four propositions, which reduce to the following. The subject wherein the image is inherent is not the object or thing seen; there is nothing without us that can be called color, or sound, hardness, odor, taste, or the like; the things that really *are* in the world without us are those motions by which the appearances of sense are caused. (*H. N.* II, 4, 10; *De Corp.* IV, 25.) Among the proofs by which the foregoing propositions are established is mentioned the phenomenon of light produced by a blow upon the eye, in which case the sensation obviously corresponds to nothing external save the motion which caused it. That ideas or phantasms are caused by motion is evident, Hobbes reasons, from the fact that they change, now appearing, now vanishing; and all mutation is due to motion.

The cognitive process may be analyzed into three factors or stages. First, an impression made upon an organ of sense by

pressure of some external object, the pressure being exerted either immediately, as in taste and touch, or mediately, as in seeing, hearing, and smelling. Secondly, this motion is continued, by means of the nerves, within the living body to the brain and thence to the heart. Thirdly, this inward motion causes a reaction at the center of life, and "an endeavour outward," which gives rise to the phenomena of sense. This outward endeavor occurs only when the reaction acquires a certain degree of strength; it explains, moreover, the external reference of sensation. A complete definition of sense is, therefore, that it is "a phantasm made by the reaction and endeavor outwards in the organ of sense, caused by an endeavor inwards from the object, remaining for some time, more or less." (*De Corp.* IV, 25, 2. Cf. also *Leviathan* I, 1.) The entire process is mechanical.

Hobbes enumerates five senses: sight, hearing, smell, taste, and touch. These have each its own sense-organ proper, and nerve for the transmission of the impression to the brain, but the internal mechanism—that is, the nerves leading to the heart, the heart itself, and the arteries which connect it with the brain—is common to all. The proper organs of touch are the nerves and membranes dispersed through the whole body. In his brief description of the sense-organs, it is evident that Hobbes was conversant with the physiology of his day, though he found it meager enough for the purposes of his psychology. Under sensations of sight are included light and color, color being "perturbed" light; under touch he mentions hardness and softness, heat and cold, wetness, oiliness, and "many more which are easier to be distinguished by sense than by words." Motion, rest, magnitude, and figure are common to sight and touch; smoothness, roughness, density, and rarity refer to figure, and are therefore likewise common to sight and touch. Sight and hearing are treated with special fullness and intelligence. (*De Corp.* and *De Homine.*) Since the nature of sense consists in motion, but one impression is possible at one and the same time, for the organ cannot be busied with two or more motions at once. Thus if two objects work together, the result will be one sensation compounded of the action of both.

Under the term imagination, Hobbes includes the phenomena of memory-images, of dreams, and of fancy, with a brief notice of after-images. The cause of memory he finds in the fact that the motions excited by the impressions of objects do not immediately cease on the removal of the object, but persist within the organism. This he proves by explicit reference to the law of inertia. (*Lev.* I, 2.) The motions produced by an object that has been removed are gradually obscured or over-

come by new motions, resulting from new impressions upon the organs. The memory-image, then, is "sense decaying" or weakening in the absence of the object. To this decay of sense is due the gradually increasing dimness and vagueness of memory-images, and the dropping out of particulars. Distance in time has an effect similar to that of distance in place, in that the whole grows dim, and loses distinction of parts, while the finer details are lost from sight. (*De Corp.* IV, 25, 7; *Lev.* I, 2; *H. N.* III, 1, 7.)

The phenomena of dreams possess a great charm for Hobbes, and he recurs frequently to the subject in the course of his writings, bringing new bits by way of comment and explanation. The images seen in dreams, he says, "have also been previously before the sense, either totally or by parcels." They differ from memory-images proper, however, in that they are, as it were, centrally excited; they result from motions originated in the heart; as, for example, cold in the internal organs generates fear, and "causeth to dream of ghosts." He notes also the incoherence of dreams, as compared with the experiences of sense, and their frequent absurdity as well.

The phenomena of after-images and of the *Eigenlicht* of the retina did not escape this acute observer, though he classes the latter with the former. "There is yet another kind of imagination which for clearness contendeth with sense, ... and that is when the action of sense hath been long or vehement; and the experience thereof is more frequent in the sense of seeing than the rest. An example whereof is the image remaining before the eye after looking at the sun. Also those little images that appear before the eyes in the dark . . . . are examples of the same." (*H. N.* III, 5.)

Memory has for Hobbes, also, the function of a sort of "sixth sense," or an "internal sense." For by the senses we take notice of the objects without us, "but we take notice, also, in some way or other, of our conceptions; for when the conception of the same thing cometh again, we take notice that it is *again* . . . . This, therefore, may be accounted a sixth sense, but internal, and is commonly called remembrance." (*H. N.* III, 6.) And in the *De Corpore*, memory has assigned to it the comparison of images, and the judgments as to likeness or difference. (IV, 25, 7.)

Fancy is distinguished from memory by two factors. It has no reference to the past; and while it draws all its material from sense, fancy arbitrarily combines and rearranges the elements thus given, as when it constructs a centaur or a mountain of gold. (*Lev.* I, 2; *H. N.* III, 4.)

Hobbes has a fairly definite and intelligible theory of Association, and one which follows logically enough from this

explanation of sensation. The succession of ideas may be either casual or orderly. Even in the former case, that of "ranging" thought, the apparently disconnected ideas may often be reduced to order by the discovery of a hidden bond of union. The orderly sequence of ideas, or "discourse of the mind," is the rule in adult mental life, and is directly conditioned by the fact that the original motions arising from the sense-impressions occur in a given order. "We have no transition," he expressly states, "from one imagination to another, whereof we never had the like before in our senses." For all ideas are motions, relics of those made in sense, and those motions that succeeded one another in sense continue together in the same order after sense, "in so much as the former, coming again to take place, and to be predominant, the later followeth by coherence of the matter moved, in such manner as water upon a plane table is drawn any way one part of it is guided by the finger." (*Lev.* I, 3.) But since in experience any given impression is followed now by this impression, now by that other, so in the mental series, association may take one of several directions, and its course cannot be predicted with certainty. This much only is certain, that each member of the series will follow its predecessors in an order at some previous time established in experience. Association by contiguity is then the sole form of association recognized by Hobbes. He does not use the term contiguity, however, or, indeed, that of association. He gives as an example of the succession of ideas the thought of St. Andrew suggested by that of St. Peter. Examples of purposely guided or regulated trains of thought are the retracing in memory a series of events, in order to fix the time and the occasion of the loss of a certain article; the passing from an event to the consequences known by experience to follow from that event, or from an imagined end to the means to that end, are cases to the point. (*H. N.* IV, 2.)

Finally in his discussion of the cognitive powers, Hobbes treats of reason. (Cf. *Lev.* I, 3, 4, 5; *De Corp.* I, 1, 2; *H. N.* IV, V.) This is a subject of peculiar difficulty for him, for since all knowledge is derived from sense, and all association of images follows the order given in sense, reason would seem to be restricted to a narrow sphere of activity. Hobbes' statement is somewhat obscured, moreover, by his differentiation of prudence from reason. By prudence he means simply forecast of the future, based upon experience. It is an accurate linking of cause and effect by means of association. As such, it is not confined to man, but is shown in some measure by animals. Reason is a higher power than prudence; it is not, like sense and memory, born with us, nor yet gained by

experience only, like prudence, but, on the contrary, is attained by industry. It consists first in an apt imposing of names, and secondly, in an orderly method of proceeding from names to their connection in propositions. The mind can have no thought or knowledge not ultimately derived from sense. Everything that is thought is particular; there are no general ideas. Names only are universal; and names are arbitrary symbols invented by man for his convenience in communicating ideas. The formation of propositions by the addition and subtraction of names, is judgment; the further manipulation of propositions into syllogisms is reasoning. Reasoning thus reduces to a form of reckoning. Reason is the peculiar mark by which man is distinguished from the animals. Children have not the power of reason until they have learned the use of speech. They may be called rational creatures, however, since they are capable of acquiring reason.

Hobbes' discussion of pleasure and pain is entirely consistent with his explanation of the cognitive powers, and forms the transition to the motive power. Pleasure and pain form, as it were, another kind of sense; they arise in consequence of the motion propagated from the sense-organs inwards, as do sensations. Motions communicated from without and continued within the body differ, however, according as they reinforce or hinder the vital motion of the organism. A motion which helps vital action is productive of a sense of pleasure, and issues in a reaction or endeavor termed *appetite*. On the contrary, a motion which hinders or impedes vital action gives rise to pain, which is the subjective counterpart of the endeavor termed *aversion*. Here we have, surely, a noteworthy anticipation of later theory. (Cf. *Lev.* I, 6, and *De Corp.* IV, 25, 12.) The internal reference of pleasure and pain is explained by the direction of the primary motion inwards, as the external reference of sensation was explained by the outward motion.

On the basis of pleasure and pain as phenomena accompanied by appetite and aversion,—endeavor towards a good, or away from an evil,—all the passions are explained. Besides the pleasures and pains of sense, are those of expectation, based upon experiences of sense. Hence, from the primitive desire and aversion are derived joy, grief, hope, fear, benevolence, anger, pity, envy, etc. The genesis of some of these is traced out at length, and in a manner which constantly suggests modern English thinkers. This derivation of the passions and emotions from self-regarding impulses has, however, more significance for ethics and politics than for psychology, and need detain us no longer.

From his discussion of pleasure and pain as subjective

aspects of appetite and aversion, Hobbes proceeds to a purely mechanical and deterministic theory of volition. A man is oftentimes in doubt concerning a thing, whether it promises good or threatens evil, and in this case appetite and aversion alternate. Or two objects of desire may be contemplated, one of which must give way to the other. In such cases, the mental state is that of *deliberation*, and the last appetite or aversion, "immediately adhering to the action or to the omission thereof, is that we call the *will*." (*Lev.* I, 6.) In common speech, indeed, we may say a man had a will to do thus and so, but forebore to do it; strictly speaking he had an inclination only. For will is the last appetite in deliberating, and is not divorced from action save by external constraint. Appetite is the internal endeavor or reaction upon some object of desire; will is the issuing of this endeavor in outward action. It makes no essential difference for Hobbes' doctrine that the object of desire may be either real or ideational.

It follows, of course, that the will is determined, and not free; for "where there is appetite the entire cause of appetite hath preceded; and consequently, the act of appetite could not choose but follow, that is, hath of necessity followed. And, therefore, such a liberty as is free from necessity is not to be found in the will either of men or beasts." (*De Corp.* IV, 25, 13.) Or, as it is stated in yet more forcible terms in the essay *Questions Concerning Liberty, Necessity, and Chance:* the choice I shall have of anything hereafter, is now as necessary as that fire will burn any combustible matter thrown into it. (*Eng. Works*, V, 295.)

The distinction between "animal" and "vital" motion corresponds to that between voluntary and non-voluntary action. Examples given of the latter are the circulation of the blood, respiration, nutrition, and other vital processes; of the former, speaking, walking, and the like. Hobbes calls attention to the fact that imagination is a factor in all voluntary motion, since all such motions "depend upon a precedent thought of whither, which way, and what." (*Lev.* I, 6. Cf. *H. N.* XII, 3.)

We have now before us, in brief, the psychology of Hobbes. From our more advanced point of view, it would be easy to point out its flaws and short-comings. Yet the range of mental phenomena included, the acuteness of observation shown in the description and explanation of the phenomena, and the general consistency of Hobbes' views with one or two fundamental principles, combine to produce a fairly clear-cut and comprehensive system. At least we may say that in spirit and aim, psychology begins to present the aspect of modern em-

pirical science. Furthermore, some of the modern problems have been raised, some of the modern solutions anticipated.

In seeking the sources of the psychology of Hobbes, we turn very naturally first to Francis Bacon. We are accustomed to look to Bacon for the beginnings of science; but is it true that psychology owes to him a debt distinct from that shared with her sister sciences? In order to answer this question, let us seek to learn in how far Bacon's writings may be said to contain a psychology, and of what sort it is. Then only shall we be prepared to say to what extent, if any, Hobbes was influenced by it in framing his own system.

In the *De Augmentis* (Bk II, ch. 1) Bacon divides all knowledge into History, Poesy and Philosophy, this division being based upon the psychological analysis of the rational soul into the three faculties, memory, imagination, and reason. History, which includes natural as well as civil history, consists in the last analysis of the facts of experience, first presented to the senses, then stored up in the memory. Poetry pertains to the imagination, by which the images of sense are variously sorted, disjoined, and formed into new and arbitrary combinations. Reason, dealing still with the given of experience, analyzes and classifies its material, and the result is philosophy, —knowledge concerning God, nature and man. History and poetry are thus concerned with individuals, but philosophy discards individuals, "neither does it deal with the impressions immediately received from them, but with abstract notions derived from these impressions; in the composition and division whereof according to the law of nature and of fact, its business lies." Here we have, in the germ, a "faculty"-psychology of a strongly empirical tendency. Knowledge begins with the particulars of sense-experience, and rises by means of the elaboration of these to general principles. (Cf. *Nov. Org.* I, 1; 19–22.)

In his further classification of knowledge, Bacon divides the doctrine of man into the Philosophy of Humanity and Civil Philosophy; under the first of these psychology finds its place, together with physiology. (*De Aug.* IV, 1.) It is somewhat startling to the reader keen for modern problems to find that the inquiry as to the nature of the bond between body and mind assumed for Bacon a place of chief importance. It is not, however, the modern problem which engages him here, but rather that of the sympathetic relation of the mental and the physical sides of man's being.

Bacon accepts from Greek philosophy the division of the soul into rational and irrational. The rational soul is divine, the breath of life breathed into man by God. As such it is incomprehensible and inexplicable, and all questions concerning its

nature belong not to psychology, but to theology. The irrational soul, however,—or, as Bacon also designates it, the "sensible" or "produced" soul—belongs both to man and to the brutes, and this forms a fit subject of human inquiry. "It must clearly be regarded as a corporeal substance, attenuated and made invisible by heat; a breath compounded of the natures of flame and air, having the softness of air to receive impressions, and the vigor of fire to propagate its action; nourished partly by oily, partly by watery substances; clothed with the body, and in perfect animals residing chiefly in the head, running along the nerves, and refreshed and repaired by the spirituous blood of the arteries." (*De Aug.* IV, 3.)

Bacon is as explicit concerning the functions of the irrational soul as concerning its nature. It is the organ of voluntary motion and of sense. He complains that neither of these powers has been properly investigated; the bare fact that the body is set in motion by the spirit, a substance vastly more subtle than the corporeal mass, is, he urges, a fact surely deserving careful inquiry, but one that has hitherto escaped it. Bacon's purpose here as elsewhere is rather to outline the problems involved, and to point out the directions which investigation should take, than to give even a tentative solution.

In his treatment of sense and the sensible, Bacon is chiefly concerned with the distinction between sensation and perception. By perception, however, he means something quite different from what that term signifies for modern thought. "Perception," for Bacon, is common to all bodies, inanimate as well as animate. All bodies, he says, exercise a kind of choice in receiving what is agreeable, and excluding what is hostile or foreign, as for instance when the magnet attracts iron, or two bubbles unite on approaching. Within animate bodies also, certain processes occur which are analogous to the examples just cited, as for instance the beating of the heart, the processes of digestion, etc. (*De Aug.* IV, 3.) All such processes or affections of bodies are, it is urged, to be carefully distinguished from sense. The distinction would seem to be that between unconscious or reflex processes and conscious affections. (See Fowler's Introd. to the *Nov. Org.*, 18–19; also Kuno Fischer's *Francis Bacon*, 273–274.) Everywhere in nature, Bacon would show, is found a receptivity for impressions appropriate to the particular body in question. The bit of iron, the chip of wood, the drop of water, each receives or repels according to its nature. Within organic bodies this primal capacity reveals itself in processes of greater complexity. In sensation, the receiving of impressions is accompanied by *consciousness* of that which is received, a new element, and one demanding attention and explanation. "Men have not seen clearly enough

of what nature the action of sense is; and what kind of body, what length of time, or what repetition of impression is required to produce pleasure or pain. In a word, they do not seem at all to understand the difference between simple perception and sense; nor how far perception may take place without sense. Neither is this a dispute about words merely, but about a matter of great importance." (*De Aug.* IV, 3.) Thus Bacon summons science to an investigation of the phenomena of sensation.

This discussion of sensation in the *De Augmentis* should be supplemented by certain passages from the *Novum Organum*, wherein Bacon points out that the impressions of sense are faulty, since they both fail us and deceive us, and hence the need of instruments to aid the senses, and of experiment. Furthermore, there is an especial liability to error in passing from sense-impressions to judgments. (*Nov. Org.* I, 50, 69.) The *Idola Tribus* and the *Idola Specus*, tendencies to error grounded respectively in human nature itself and in the peculiar constitution of individuals, have a bearing upon problems of psychology, in that they mark a distinction between sensations within us and things without us, and raise the question as to the nature and correctness of our perceptions, as well as note the fact of individual variations in psychical functioning. (*Nov. Org.* I, 41–42. See also K. Fischer's *Francis Bacon*, 82–83.)

According to Bacon's classification, the understanding and reason are delegated to logic; the will, affections and appetites to ethics. Logic and ethics, therefore, fall under psychology. Imagination acts as a messenger or proctor in both provinces, carrying over the images of sense for the judgments of reason and the mandates of the will. (*De Aug.* V, 1.) Incidentally he comments upon the part played by imagination in voluntary motion. The image serves as the object and guide of the motion, as proved by the fact that when it is withdrawn the motion is immediately interrupted. As an example he cites the case of a person walking, and brought to a standstill in consequence of absorption in some object of thought.

The faculty of memory is treated briefly in the *De Augmentis* (V, 5), and at greater length in the *Novum Organum* (II, 26). Bacon's discussion of memory is prompted by the practical aim of establishing an effective mnemonics, but has interest as containing some forecast of a theory of association. He enumerates six ways by which memory is facilitated. (1) By cutting off of infinity of search, which may be done by noting the order or distribution, by the artificial assignment of "places" (either places in the proper sense of the word, or any arbitrary sign, as words, letters, historical persons, and the like), or by taking advantage of the rhythm and rhyme of

verse. (2) By the reduction of the intellectual conception to a sensible image. (3) By impression made on the mind in a state of strong emotion. (4) By impression made on the mind when unoccupied with anything else either before or after. (5) By a multitude of circumstances or points to take hold of. (6) By expectation.

The will, as has been said, falls within the sphere of ethics, and is considered by Bacon wholly with a view to practical or moral interests.

Not the least interesting and instructive of Bacon's opinions which have significance for our inquiry, are those found in the *De Augmentis* (VII, 3), where he makes suggestions towards a social psychology. Here he insists that the characters and dispositions of mind be investigated with scientific accuracy, both those which are common to all men, and those which are peculiar and individual. Hitherto astrology alone has concerned itself with this study, and that in a superficial and unscientific manner. He would have a careful investigation now instituted, with a view to ascertaining what are the common and simple elements in mental life, and how these are modified by age, sex, region of country, disease, deformity, station in life, wealth, poverty, prosperity, adversity, and so on. The affections and passions should be included in this research. Philosophers ought carefully and actively, so Bacon says, to have inquired concerning the strength and energy of custom, exercise, habit, education, imitation, emulation, friendship, praise, reproof, and so forth.

So much for Bacon's psychology. To quote Fowler: "It is impossible not to see in these speculations, crude as some of them are, the beginnings of much of the later English psychology." (Fowler's Introduction to the *Nov. Org.*, p. 19.) Bacon gives almost nothing by way of theory; his thought is scarcely systematized. It is not so much a psychology that we find, as suggestions as to what psychology must be. We do not forget that Bacon's service to science in general was not in the form of definite contributions to the sciences, but rather in his insistence on a wider range of investigation, a freer spirit of inquiry, and, above all, a new method. He was the prophet of a new dispensation; gifted with clearer vision than his fellows, he called upon men everywhere to repent of the sins of their enslaved past, and do works meet for such repentance.

In tracing the influence of Bacon upon Hobbes, we find ourselves upon debated ground. The dispute has reference chiefly to the general philosophical influence of Bacon, rather than to the narrower question in which our interest centers, but is not without a bearing upon the matter in hand. Fowler and Kuno

Fischer agree in asserting that Hobbes is the disciple of Bacon, that the thought of the former is rooted in that of the latter, and grows out of it logically and unmistakably. It seems no less certain that other influences, chiefly continental, were at work upon Hobbes, and did much to mould his thought.

But little significance can be attached to the circumstance that in all his writings Hobbes makes but two references to Bacon, and these of a trivial nature. (Nichol's *Bacon* in B. Ph. Classics, Vol. 2, p. 235; Fowler's *Introd. to Nov. Org.*, p. 99.) It is certain that the two men had personal dealings; it seems certain, on the authority of Aubrey, that Bacon employed Hobbes to translate some of his works into Latin, "finding none able so readily to understand his thoughts in them." However this may be, on *a priori* judgment, one would pronounce it to be impossible that Hobbes should have been unacquainted with and uninfluenced by the writings of his distinguished contemporary and fellow-countryman. Bacon's influence upon Hobbes is chiefly a matter of tendency and attitude rather than of direct transmission of doctrine, and for this reason more readily eludes exact definition, while it is not less real and potent.

Perhaps the first thing to be noted in Bacon which has a distinct bearing upon the psychology of Hobbes, is the marking off of the field of psychology from metaphysics. Bacon, we remember, divides the soul into rational and sensible parts. The former, being wholly incomprehensible to human reason, he turns over with cheerful alacrity to theology; the latter furnishes the field of psychology. Thus, at the outset, psychology is guarded in large measure against entanglement with metaphysical questions,—much as we may deprecate the means by which this result is effected. To use Fowler's words: Bacon assumes from the start the ordinary distinction between mind and matter, a universe of objects to be known, and a thinking subject capable, by care and discipline, of attaining to a knowledge of them. (Fowler's *Introd.* to *Nov. Org.*, p. 16.) Psychology is not concerned with the proof of these presuppositions. It is on the same level with the other sciences in that it has for its aim the investigation of a definite group of phenomena. It was no small service in the interests of psychology thus early to define its sphere and to insure its title to a place among the sciences.

In this dualism of Bacon's, just noted, is to be found, doubtless, one source of the materialism of Hobbes. As Kuno Fischer says, the hiatus between the rational and the sensible soul led logically to the denial of that which is in itself inexplicable, and superfluous for mental life. (*Francis Bacon*, pp. 270-271.) Lange cites as evidence of the materialism of Bacon his high

estimate of Democritus, whose system he places above all others, and also Bacon's doctrine of "animal spirits." Says Lange: "We have the thing (materialism) in all essential respects in Bacon, and we are only restrained from designating Bacon as strictly the restorer of the materialistic philosophy by the circumstance that he fixed his attention almost exclusively upon method." (Lange's *Hist. of Materialism*, I, 236.) Bacon's psychology is virtually materialistic, that of Hobbes frankly and explicitly so.

Along with Bacon's service in defining the field of psychology must be named that other incalculable service of indicating its method. Psychology, as well as the other sciences, must proceed by induction. In the case of psychology no less than of the physical sciences does Bacon bewail the lack of patient and accurate observation and collection of facts. He does not seem to have foreseen the possibility of the application of experiment within the field of psychology, but his spirit is essentially that of modern scientific research. We have already noted that Hobbes proceeds by the empirical method. He does not profess Bacon's disdain for deduction; instead, he combines deduction with induction. He is far too thoroughly imbued with the spirit of Bacon to pass over the importance of facts, or to think he has explained when he has merely described.

In close connection with the above we must note the sensationalism of the psychology of Hobbes. Bacon had insisted upon experience as the sole source of knowledge. But according to his psychology experience is reducible to sensuous elements. The higher processes of thought and inference are, first for Bacon as later for Hobbes, merely means of elaborating the material furnished in sense. Nothing new is added at any stage in knowledge. Words are but arbitrary signs attached to groups of things for convenience of reference. Hence follows "a predilection for a mechanical theory of the universe." (K. F.'s *Francis Bacon*, 412.) Sense holds the same fundamental place in Bacon's psychology as in that of Hobbes. Upon it all higher functions are built, to it they appeal for their entire contents. Bacon shows also, but to a much less marked degree than Hobbes, the tendency to seek in physiology the adequate explanation of psychical phenomena.

To mention some specific and minor points of the indebtedness of Hobbes to his predecessor. Bacon had already emphasized the subjective character of sensation: color, sound, and other sense qualities exist for the sentient subject, not as properties in the object. (*Nov. Org.* I, 41-42.) Bacon's peculiar doctrine of perception as common to all bodies may have some bearing upon Hobbes's mechanical explanation of sensation. If regarded as the extension to the lower forms of organic life

and to inorganic bodies of a property universal in higher organic life, then the doctrine is an anticipation of Leibniz. For Hobbes it may have meant the extension of the mechanical principle ascribed to natural bodies to mental life. We have to look elsewhere, however, for the true source of Hobbes' mechanical conception.

So far as Bacon explains the physiological conditions of sensation, his statements agree with the fuller explanation of Hobbes. Both give to the heart the primacy over the brain as the central organ of sense, for instance. Hobbes certainly owes to Bacon the suggestion that the ideational element enters as a factor into voluntary motion. Bacon's enumeration of the various ways by which memory may be facilitated may well have led Hobbes on to his own theory of association. Bacon is one of the most suggestive of writers on any theme, and in his psychology the reader is impressed by the numerous suggestions thrown out, foregleams of later thought as they seem in retrospect. One cannot state dogmatically that they influenced Hobbes, or subsequent writers. They may very well have done so.

While the continuity of thought from Bacon to Hobbes is too obvious to admit of permanent doubt, it is equally indubitable that the thought of the latter was shaped in no small measure by the action of another current of influence proceeding from the continent, notably from Descartes and that group of scientific thinkers among whom Galileo shone preeminently. The key-note of the entire speculation of Hobbes is mechanism. "He finds his mission," says Falckenberg, "in the construction of a strictly mechanical view of the world. Mechanism applied to the world gives materialism; applied to knowledge, sensationalism of a mathematical type; applied to the will, determinism; to morality and the state, ethical and political naturalism." (Falckenberg's *His. Mod. Phil.*, p. 72.) We have seen how thoroughly the mechanical view dominates his psychology. Sensation, memory and imagination, affection and will, are all explained by motion, imparted in the first instance by impact. Motion is the ultimate principle. Motion, in accordance with invariable law and capable of expression in mathematical formulae, was at this period the ruling idea of the new physical science. Mathematicians and astronomers were busy revealing a new heaven and a new earth obedient to laws of motion. What more reasonable than the hope that an idea, proved so fruitful in natural science, would prove equally fruitful applied to the varied phenomena of the life of man? This was the thought that lodged in the mind of Hobbes, grew until it dominated

all his thinking, and expressed itself in his system of philosophy.

That Hobbes did actually come in touch with the men who represented most fully the new scientific movement, is established by the facts of his history; and that he was keenly alive to the significance of their work receives abundant proof from direct statements and references to be found in his writings. During the years 1610-1637, Hobbes made three journeys to the Continent, remaining at one time for a period of three years. He made the acquaintance of Gassendi, Mersenne, and Galileo. These journeys are memorable as occasions of fresh intellectual stimulus. It was on the first of them that he took up for the first time the study of geometry, to which he applied himself with infinite zest. During the third journey the idea of motion took possession of his mind. Day and night he was haunted by it, he tells us; whether he sails, drives, or rides, there motion is forever meeting his eye, engaging his thought, and offering itself as the clue to the mystery of the varied universe. It seemed to him that there is nothing real in the world save motion. (*Vit. carm. exp.* L, 1, 89. See, also, Robertson's *Hobbes* in Bl. Ph. Classics, pp. 33-34.) Returning in 1637 from his third tour on the Continent, he found England rent by partisans and on the verge of civil war, and, after a brief tarry, went abroad again, remaining this time for eleven years. This period of his exile covers the productive years of the life of Descartes, who was himself an exile in Holland for prudential reasons, but made several visits to France during the time of Hobbes' protracted residence there. Mersenne was in communication with Descartes all the while, and it was through his efforts that Hobbes was induced to add his "objections" to those appended to the *Meditations*, which appeared in 1641. We learn that Descartes was displeased with the tone of Hobbes' criticisms, and would have no further correspondence with their author. (Mahaffy's *Descartes*, Bl. Ph. Cl., p. 95.) Gassendi—of whom Lange says that he was the forerunner of Descartes—was entering upon the period of his greatest literary activity. He became Regius Professor of Mathematics at Paris in 1646, and his lecture-room was crowded with eager hearers. (Lange's *Hist. of Materialism*, I, 263.) Kepler's work had been finished some years before. Galileo was at the height of his fame and activity. His greatest contributions to science had already been made. The law of falling bodies, the diurnal and annual motions of the earth, the ebb and flow of the tide, the discovery and revolution of the satellites of Jupiter,—these and other results of Galileo's research were before the world. Hobbes' own countryman, Harvey, had published his notable

discovery as early as 1628. (*Exercitatio Anatomica de Motu Cordis et Sanguinis.*) It was not until after 1650, subsequent to his return to England, that the chief works of Hobbes appeared in print.

The references made by Hobbes to the scientific thinkers just named are very numerous, being scattered throughout his works, and show him to have been thoroughly familiar with their views. (Notice especially *Epistle Dedicatory*, *De Corpore.*) An interesting bit of personal history, related by Hobbes himself, tells us how his thoughts were first directed to the problem of sensation, and how he turned at once to motion for the key to the solution. In conversation one day with a group of learned men, some one made mention of sense, and another asked in the spirit of Pilate, "What is sense!" No one being able to answer, he was filled with wonder that men of such wisdom should not understand the nature of their own senses, and from that day he pondered the matter. Then it occurred to him that if bodies and their internal parts were at rest, or were moved always in the same way, there could be no distinction of anything, and consequently no such thing as sense. The cause of all things must be sought in diversity of movements. (*Vita*, L, 1, p. xx. See, also, *Hobbes* in Bl. Ph. Cl., 33-34.)

The influence of Descartes upon the psychology of Hobbes deserves a special consideration. The dualism of Descartes set mind and body over against each other in marked antithesis. On one side, everything is to be explained in terms of thought; on the other, in terms of extension and motion. The rationalistic element in Descartes would seem to have had little interest for or effect upon Hobbes. It is Descartes' use of the mechanical principle which is of chief importance for our problem. Descartes it was who, starting out from the idea of motion, first attempted an explanation of the entire universe on mathematical and mechanical principles. We remember that Descartes himself considered his metaphysical theory merely as preparatory to his scientific and mathematical inquiries. (*Essay on Method*, I, 191, Cousin's ed.) Certain epistemological questions must first be answered. His great aim, however, was to work out a complete and consistent mechanical explanation of all natural phenomena. Descartes' "vortex" theory is an attempt to explain the origin and laws of the solar system in terms of motion. (Cf. Mahaffy's *Descartes*, 159-160; *Descartes and His School*, 400-403; see also Tönnies' *Hobbes, Leben und Lehre*, p. 100.) All the phenomena of nature he believes are to be explained as modes of motion. His earliest published statements of his mechanical theory are the essays on *Meteors* and *Dioptric.*

But the phenomena of the life of man, according to Descartes, are likewise capable of explanation by reference to motion. Life itself is mechanism. Human and animal bodies are automata, wholly explicable by the principles of motion and heat. Sensation and appetite in brutes are mere appearances, physical reactions without correlates in consciousness, and even in man they are mechanical processes. (Cf. *Descartes and his School*, 412.) Here, obviously, is the source of the mechanism which pervades the psychology of Hobbes.

Turning from his general conception of nature to his psychology, we find that Descartes recognized six grades of mental function (Falckenberg's *Hist. Mod. Philos.*, 105): 1. The external senses. 2. The appetites. 3. The passions. 4. The imagination, with its divisions into passive memory and active phantasy. 5. The intellect, or reason. 6. The will. Sensations and appetites, since they belong to the body, are mechanical in origin and nature. They are for Descartes, as for Hobbes, modes of motion. Moreover, since he rejects the idea of action at a distance, Descartes makes all phenomena of motion due to pressure. The passions belong both to body and soul, thus forming a group intermediate between the lower and the higher groups. Mind would not be capable of passion but for the concurrence of the body. The fundamental forms of passion are wonder and desire, the term desire being made to include both the desire to get pleasure, and aversion, or the desire to shun pain. By wonder Descartes seems to mean a state of interest, but neutral as to pleasure and pain. Out of these primary passions all others are elaborated. From pleasure and pain arise desire and aversion; desire and aversion projected into the future are hope and fear; hope and fear realized give rise to joy and grief, and so on. All are strictly self-regarding.

Even this cursory glance at his psychology makes it appear that the profound intellect of Descartes had previously worked over the same ground and arrived at some of the same conclusions as Hobbes. Nor is this to deny to the latter originality of thought. The psychology of Hobbes is no mere resetting of the opinions of Descartes. It has a scent of English soil, and a vigor which testifies to the grappling with problems at first-hand. It is worthy of note, perhaps, that the references of Hobbes to Descartes bear almost without exception upon the speculations of the latter within the field of the physical sciences, but are such as to show familiarity with the details of his thought within that field.

To Bacon, Hobbes would seem to owe his conception of psychology as a science, and the distinctively empirical bent of his

thinking, and to be further indebted to him for various suggestions which he worked out and incorporated in his own system. From Descartes, Hobbes undoubtedly got the conception of nature as a mechanical system, and the idea of the extension of the mechanical principle to physiology and psychology. He went further than Descartes in reducing all mental activity to modes of motion, thus resolving the dualism of Descartes into materialism pure and simple. To the physical sciences of his day, primarily, Hobbes owes the principle by which he explains every form of mental phenomena.

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EXPERIMENTS ON DISCRIMINATION OF CLANGS FOR DIFFERENT INTERVALS OF TIME.

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PART I.

The following research was suggested by the results of experiments on memory carried on by a beginner's class in psychology in Stanford University.

These experiments were of the usual kind on syllables, numbers, weights, tones and lines. They were carried out under fairly favorable conditions as regards isolation, and with much earnestness by most of the class — a condition not always present in beginners' classes in experimental psychology.

The general results of the experiments were not such as to substantiate all the laws of memory as commonly laid down in the text books. It was not found, for example, that the flight of time up to 60 seconds—the longest interval used—made any marked difference in accuracy of discrimination of lines for most of the students. The majority seemed to discriminate as well with a 60-second interval as with 10 or 3 seconds. It was further noticed that the degree of strain of attention during the interval between two stimuli seemed to make but little difference in accuracy of discrimination. One student, *e. g.*, who filled in longer intervals with interesting reading, discriminated between pairs of lines, quite as well for the longer intervals as for the shorter with direct attention.

Again, while some were more accurate with the shorter intervals, others were more accurate with the longer, so that the average of the judgments of about 30 students was almost alike for all time-intervals used. But the experiments on each individual were too few in number, and performed under too rough conditions, to serve other than as hints for more careful and extended work. They led the writers to think, however, that the so-called laws of memory for short intervals of time as commonly laid down in text books may be inaccurate; and, also, that the lumping together of experiments on series of syllables and numbers on one side, with experiments on the discrimination of pairs of successive stimuli on the other, under the common name of "memory experiments," is misleading.

Furthermore, the writers thought it might be worth while to repeat some of the experiments on discrimination of simple stimuli with different time intervals under the conditions of strained and distracted attention,—to repeat, for example, Wolfe's work on Tone Memory, and to supplement it with distraction experiments, in order to gain some insight, if possible, into the nature of the "memory image" of simple stimuli.

The literature of the experimental treatment of memory, so far as it is accessible to the writers, would not seem to indicate that the question of the effects of the flight of time on memory had been definitely settled, or, indeed, that it had been definitely determined what was meant by memory in experimental investigations.

The diversity of result obtained in the beginners' class, referred to above, seems to be a reflection of the diversity of result found in the several special investigations. Wolfe's[1] well known work on Comparison of Clangs, from which he obtains a logarithmic law similar to Ebbinghaus's law for the forgetting of nonsense syllables, will be discussed further on, along with the results of the writers' experiments. In regard to the classical research of Ebbinghaus, as well as of the supplementary work of Müller and Schumann, the writers, as indicated above, do not feel that the effect of the flight of time on a series of muscular actions, practiced till they can be executed mechanically, is to be placed in the same category with the discrimination of pairs of successive, simple stimuli, with different time intervals. As M. Bergson[2] says in the *Revue philosophique*, "The recollection of anything learned by heart, has all the marks of a habit. Like a habit, it is acquired by repetition of the same effort. Like a habit, it requires analysis of an action and then recomposition into the complete effect. Like any habitual exercise of the body, it is incorporated in a closed series of automatic motions which follow one another in the same order and take up the same time."

What is there in running through a complicated series of muscular actions which corresponds to the discrimination of two tones, except the element of the flight of time? The impressions of "like" or "unlike" expressed in judgments, are the data from which the accuracy of the so-called sensory memory is estimated; but the accuracy of reproduction of a series of muscular actions, more or less accompanied by sensory images, and discharging into one another more or less mechani-

[1] Wolfe: Untersuchungen ü. d. Tongedächtniss. *Phil. Stud.*, Vol. III, p. 534.

[2] Bergson: Mémoire et reconnaissance. *Rev. phil.*, Vol. XLI, p. 226.

cally, is the basis for measuring the memory for motor ideas, and a subsequent judgment of the degree of accuracy of reproduction does not form an essential part of the data. Moreover, the consciousness of the serial impressions retreats more and more with practice, into the marginal regions of consciousness, whereas, in the case of discriminative judgments, the attention usually becomes more and more concentrated and the discriminative powers increase with practice.

In this respect, Ebbinghaus's observation on the effects of recognition of syllables on retention seems very pertinent. He found, for example (Das Gedächtniss, S. 80), that syllables, which he had imprinted 8 to 16 times on a given day, appeared new and strange to him on rehearsing them the day following. When, however, the number of preparatory imprintings had run up to 57 or 64, the syllables no longer appeared strange to him on the succeeding day; he greeted them, if not immediately, at least in a short time, as old acquaintances. But he did not find that recognition of the syllables made any difference in regard to their retention. The number of imprintings necessary to memorize the syllables was as great with as without recognition.

Müller and Schumann[1] found a like result in the case of rows of syllables reconstructed wholly from rows already imprinted. When, however, the reconstructed rows were made up in *part* only from previously imprinted rows, they found a saving in time of memorizing accompanying recognition. But this latter condition was attributed by them to a great familiarity with certain syllables, or to some betterment in "disposition," in virtue of which attention and recognition were both increased. The quickening effect on interest of a familiar acquaintance in a mixed translocated series of syllables, as compared with the broad and general recognition of Ebbinghaus's experience, would certainly account for the difference in results. It would seem to the writers as if the classification of the two forms of mental process under the common name of Memory, rests on a loose analogy—viz.: the analogy between the motor tendencies together with more or less of sensory accompaniment, left by imprinting a series of muscular actions, and a so-called memory image resulting from imprinting a sensory image, which is supposed to exist centrally till it is compared with a peripheral sensation. Whether, however, this memory image as such exists in most of our discriminative judgments for small differences of stimuli is doubtful. As will be shown later, explanations of sensory memory based on the existence of a memory image involve one in absurdities.

[1] Exp. Unt. ü. d. Gedächtniss. *Z. f. Psy.*, Vol. VI, p. 319.

Bigham's[1] experiments on memory are of the serial kind, but the imprintings were not repeated till the reproduction became automatic. Using 10 kinds of serial presentations—5 audible and 5 visible—he found, in general, an increase in errors of reproduction with the time. Nevertheless, taking the different kinds of presentations together, using all the syllables and all the numbers (as we understand it), he found that numbers were remembered better after 10 than after 2 seconds, and that syllables were "remembered very much better after 30 seconds than after 2 or 10 seconds." But the reproduction of a series of visible presentations is often attended by, if not due to, muscular action. The names of colors, figures, and numbers are almost unavoidably pronounced as they are exposed, and it is questionable if in this kind of experiment, any more than in those of Ebbinghaus, we have mental processes similar to those involved in discriminating between pairs of stimuli.

Münsterberg[2] compared linear distances with intervals of 1, 3 and 10 seconds, and found an increase in variable error with the time. Lewy,[3] elaborating on Münsterberg's work, found an increase in variable error with the time for intervals up to 60 seconds. Lewy used the method of mean error, which necessitated an adjustment of the comparison distance till it seemed like the same. This occurred after the time interval had expired. Consequently, in case the adjustment took a second, the time interval would have been stretched all the way from 100 to 20 per cent. of itself for the intervals from one to five seconds. As the writers used clangs rather than lines in their investigations, Lewy's objections to the use of clangs may be briefly noticed. In the first place he says that even with pure tones, harmonics can crowd into memory and disturb it. In the course of long experimentation with tuning forks, one of the writers has not found this to be the case. Lewy next objects, that by means of gentle "Mitsingen" the reagents would be able to fix the norm. The obvious answer to this is that the differences used in discriminative experiments are too small to be reproduced by singing. As Stumpf[4] says: "Would the most practiced singer venture to produce 90 different tones within the half-tone interval from h^1 to c^2? But this is the number of differences that can be detected by practiced ears." Lewy also found an increase of variable error with the time, in localizing points on the skin.

Some experiments by Paneth and Wahle, communicated by Exner, illustrate the contradictory condition of the memory

[1] J. Bigham: Memory. *Psy. Rev.*, Vol. I, p. 453.
[2] Münsterberg: Beit. z. exp. Psy., Vol. II, p. 163.
[3] Lewy: Unt'r'g ü. d. Gedächtniss, *Z. f. Psy.*, Vol. VIII, p. 231.
[4] Tonpsychologie, Vol. I, p. 163.

problems. Paneth[1] tried to reproduce a time interval by pressures on a key connected with a kymograph. As a result of 1,451 trials, he found that the "sharpness of the memory image" declined so little in the course of five minutes that the difference could not be measured by the method used. Wahle experimented with white disks on a black ground (surface magnitudes), and later with just observable differences of brightness. Exner does not give the details of these experiments—he simply says: "They were conducted with the same care and gave rise to the same negative results as Paneth."

The experiments of Baldwin and Shaw[2] and of Warren and Shaw[3] are not strictly to be compared with those of Wahle, as they obtained their data from 'class experiments,' carried out for much longer intervals (10, 20, 40 minutes), which were 'filled' with class work. In general, they found a decrease in accuracy of selection or identification with increase of time. In reproducing a given square, however, the class error for 40 minutes about equalled that for 20. In regard to this the authors say that the class may have been tired or the paper on which the squares were drawn, too small. In view of the contradictory results of various experimenters, it is perhaps also admissible to say that, under the conditions, a class could reproduce a given square as well after 40 minutes as after 20.

Other experiments of Münsterberg[4] as well as those of Smith[5] are not considered here, partly because they are serial, and partly because they have to do with questions of distraction, which will be discussed in the second part of this paper. We turn, therefore, to a closer examination of Wolfe's experiments.

The stimuli used by Wolfe were clangs from an Appunn 'Ton-Messer,' and they lasted one second, as nearly as the operator could pull the stop. For the experiments of the first of the two periods into which the entire work was divided, 5 different clangs were used to avoid the possible formation of a sense of absolute pitch. The time intervals between norm and comparison ran from 1 to 120 seconds—the greater part lying between 1 and 60 seconds. Intervals up to 30 seconds were marked by a metronome. In this connection it is curious to observe that metronome beats have been used sometimes as

[1] Paneth: Versuche ü. d. zeit. Verlauf d. Gedächtnisses. *Cen. Blatt. f. Phys.*, Vol. IV, p. 81. Mitgetheilt von Sig. Exner. Cited also by Lewy, S. 234.

[2] Baldwin and Shaw: Memory for Square Size. *Psy. Rev.*, Vol. II, p. 236.

[3] Warren and Shaw: Memory for Square Size. *Psy. Rev.*., Vol. II, p. 239.

[4] Münsterberg: *Z. f. Psy.*, Vol. I, p. 115.

[5] Smith: Attention and Memory. *Mind*. N. S., Vol. IV, p. 47.

a means of distraction, sometimes without being noticed, and sometimes with even the effect of fixing the attention on the regular stimuli.[1] It illustrates the complexity of the distraction problem that the same kind of stimulus should come to produce either fixation or distraction according to the attitude of the reagent. From the experiments of the first period with difference of 4 vibrations, as Wolfe himself says, not much is to be concluded, as the flight of time had but little effect in comparison with the uncertainty of the reagents in judging 'higher' and 'lower.' Perhaps the most pronounced result was that with no difference in vibrations between norm and stimulus ($\Delta=0$), the proportion of correct judgments was large with small time intervals, and fell off with increase in time. With $\Delta=8$, there was some, though not marked, increase of right judgments (r) over $\Delta=4$. In this case also r decreased with the time, though not so much as for $\Delta=0$. Similar results are found for $\Delta=12$.

In Wolfe's numerous experiments of the 'second period' 11 norms were used to avoid the formation of a sense of absolute pitch. These norms ran from 144 to 1,004 vibrations, giving opportunity, incidentally, to investigate the relation of liminal differences to pitch.

The number of reagents was 4—Wolfe himself acting at once as reagent and experimenter, giving far more judgments than any other reagent. For all reagents, and for all values of Δ, viz., 0, 4 and 8, there was a falling off in accuracy of judgment with the increase in time interval—the decrease being most marked for $\Delta=0$. Accordingly, the well known curves for tone-memory, together with the logarithmic law, are deduced from cases where there was no difference between norm and comparison.

The experiments of the writers were also performed on an Appunn 'Ton-Messer,' with the range of an octave, viz., from 512 to 1,024 vibrations with a difference of 4 between consecutive stops. The reagents were 4 in number—Mr. G. E. Libby, Mr. Wilson, Miss Steffens, and one of the writers (F. Angell). All could or would sing a little, but in Germany, at any rate, would hardly be regarded as musical. They sat with their backs to the instrument and ten (10) feet away from it. The matter of distance is not unimportant, as for a distance of less than a meter from the instrument reagents would be able to recognize a difference in the positions of two stops, differing by eight vibrations. Two of the reagents were unacquainted with the object of the experiments, and to this day three are unacquainted with the result. None of the reagents, during

[1] Wolfe: *op. cit.*, S. 530.

the course of the investigation, had the slightest information in regard to the results or the general trend of the experiments, nor were they aware of the differences judged. They were told to judge each pair of stimuli as if it was the only pair, and to beware of forming any theories in regard to the succession of norm and comparison. Of course they were to note anything in their judging which appeared to them noteworthy. On account of the variations introduced into the work by the experimentation on distraction, it was impossible to make use of a large number of norms. Accordingly, one of the three clangs corresponding to 540, 560, or 580 vibrations was used as *the* norm for a series of 10 judgments, and at the same time this norm might be varied 4 vibrations either way. Thus, in a series of 10 judgments the noun 560 might be raised to 564 or lowered to 556. In this way all danger of forming a sense of absolute pitch was avoided.

The reagents were told at first to judge merely "like or unlike," but before the practice period was over, they gave the judgments 'higher' or 'lower' without thought of "like or unlike." Accordingly the ratios of right and wrong cases in tables of for 'unlike' judgments are based on judgments of 'higher' and 'lower.' Doubtful judgments are divided proportionately between right and wrong judgments. The differences used were $\Delta = 0$, $\Delta = 4$, and $\Delta = 8$, but as the reagents knew nothing in regard to the size or variations of Δ, their attention was presumably equally strained for all of its values. Nine time intervals were investigated, viz., 1, 3, 5, 7, 10, 20, 30, 40, 60 seconds. Along with the experiments ran a series with distracted attention, the results of which are incorporated with the pure memory experiments for the sake of economy of space.

For each time interval about 90 judgments were given by each reagent with distraction, and 90 without. Of these judgments about ¼ were given on a difference $\Delta = \pm 0$, the remainder being almost equally distributed between $\Delta = \pm 4$, and $\Delta = \pm 8$. Table I gives the actual results of experimentation after practice, and Table II gives the percentage of right cases in Table I for each value of Δ. As will be seen from Table II, the falling off in accuracy where $\Delta = \pm 4$ or ± 8 is small. It is more marked in the case of A than of the others, though one finds that A with $\Delta = 4$ is as accurate for 60 seconds as for 5, and more accurate than for 40 seconds. S. on the other hand shows greater accuracy in judging these differences for the longer time intervals. For $\Delta = 8$ her average per cent. for the 4 shortest intervals (1 to 7 seconds) is 56: for the 4 longest intervals (20 to 60 seconds) it is 59. For $\Delta = 4$ the difference is still more marked, the average for the first 4 intervals being

TABLE I.

Actual number of right (r), wrong (w), like (111), *and doubtful (?) judgments for each of the four reagents, L., W., A., S., for each time-interval (t-i) and for each difference* (△) *of 8, 4 and 0 vibrations, with and without distinction* (D).

LIBBY.

t.-i.		1		3		5		7		10		20		30		40		60		
			D		D		D		D		D		D		D		D		D	
△=±8	r	56	52	37	39	36	34	36	28	40	38	43	34	39	41	33	30	29	29	
	w	1		2			1				2	1	1	3	3	1	6	4	5	
	111	2		1	1									2		2	1	1	1	
	?	1					1						1					1		
		60	52	40	40	36	36	36	28	40	40	44	36	44	44	36	36	35	35	total= 718
△=±4	r	18	26	31	34	37	38	32	45	32	34	29	36	26	30	28	28	26	30	
	w	1	2	4	3		4	4	3	1	3	5	6	7	5	6	7	7	4	
	111	1		7	3	7	2	7	3	5	3	2	2	1	1	3	1	2	1	
	?	1						1	3	2				2				1	1	
		21	28	42	40	44	44	44	51	40	40	36	44	36	36	37	36	36	36	total= 691
△= 0	r	19	16	16	12	14	3	10	5	11	2	6	1	5	1	6	0	2	1	
	w	1	4	4	8	6	17	10	15	9	18	14	19	15	19	12	18	16	17	
	?																			
		20	20	20	20	20	20	20	20	20	20	20	20	20	20	18	18	18	18	total= 352

Total judgments for L.=1,761

WILSON.

t.-i.		1		3		5		7		10		20		30		40		60		
			D		D		D		D		D		D		D		D		D	
△=±8	r	54	41	36	36	35	29	33	24	38	36	40	31	37	34	32	29	29	29	
	w	6	10	3	3	1	6	3	2	2	4	4	7	5	9	2	7	5	7	
	111		1	1					1					2	1	1		2		
	?				1											1		1		
		60	52	40	40	36	35	36	27	40	40	44	38	44	44	36	36	37	36	total= 721
△=±4	r	14	22	28	26	22	30	36	34	26	27	23	32	27	26	24	22	24	20	
	w	5	4	7	12	15	12	3	14	9	11	12	10	7	7	6	8	8	11	
	111	1	2	4	1	6	2	5	4	5	2	1	2	1	2	5	4	3	1	
	?			1		1								1	1	1	2		4	
		20	28	40	39	44	44	44	52	40	40	36	44	36	36	36	36	35	36	total= 686
△= 0	r	19	16	17	14	18	12	15	12	17	9	11	8	11	3	7	9	3	5	
	w	1	4	4	5	2	8	5	7	3	11	9	12	8	13	11	10	14	10	
	?										1			3	2			1	2	
		20	20	21	19	20	20	20	19	20	21	20	20	22	18	18	19	18	17	total= 352

Total judgments for W.=1,759

TABLE I.—(*Continued.*)

ANGELL.

t.-i.		1		3		5		7		10		20		30		40		60		
			D		D		D		D		D		D		D		D		D	
Δ=±8	r	51	44	33	33	29	27	27	22	31	30	30	30	34	33	30	26	26	26	
	w	3	1					2				1		2		3	1	3		
	111	2	1	1	2	1	4	3	1	3	1	3	4	2	3	3	3	1	8	
	?		2	2	1	2	1		1	2	5	2	2	2	4		4	6	2	
		56	48	36	36	32	32	32	24	36	36	36	36	40	40	36	34	36	36	total= 662
Δ=±4	r	10	17	25	14	19	16	24	29	21	22	22	21	20	17	16	15	18	18	
	w	1		1	1	3	2	2	5	3		1	2	3	2	5	7	6	5	
	111	4	7	8	19	11	15	14	14	11	10	9	9	8	9	12	9	8	10	
	?	1		2	2	3	3			1	3	4	3	1	4	3	3	3	2	
		16	24	36	36	36	36	40	48	36	35	36	35	32	32	36	34	35	35	total= 618
Δ= 0	r	14	16	18	14	15	9	15	11	15	11	14	7	12	7	9	5	5	6	
	w	2	2		3	1	6	3	6	3	4	4	6	4	10	8	9	12	8	
	?	2		1		2	3		1		3		5	2	1	1	4	1	3	
		18	18	19	17	18	18	18	18	18	18	18	18	18	18	18	18	18	17	total= 160

Total judgments for A.= 1,440

STEFFENS.

t.-i.		1		3		5		7		10		20		30		40		60		
			D		D		D		D		D		D		D		D		D	
Δ=±8	r	34	32	23	27	17	14	25	19	21	20	20	14	23	25	18	20	22	19	
	w	25	20	15	13	19	21	11	9	15	18	16	17	17	15	16	10	13	17	
	111						1					1	1							
	?			2												2	2	2		
		59	52	40	40	36	36	36	28	36	38	37	32	40	40	36	32	37	36	total= 691
Δ=±4	r	9	16	18	19	17	19	25	30	18	17	19	26	18	18	23	15	19	25	
	w	9	10	24	18	27	24	17	19	17	17	13	13	14	14	13	15	15	10	
	111	2	2	2	1				1	1	2						1			
	?				1		1	1	1			1					1	1	1	
		20	28	44	39	44	44	43	51	36	36	33	39	32	32	36	32	35	36	total= 660
Δ= 0	r	18	12	12	5	7	5	8	2	7	3	1	1					1	1	
	w	2	8	8	14	13	15	12	18	11	14	17	16	18	18	18	15	17	17	
	?				1						1		1				1			
		20	20	20	20	20	20	20	20	18	18	18	18	18	18	18	16	18	18	total= 338

Total judgments for S.= 1,689

TABLE II.

Percentage of right judgments in Table I.

		t.-i. 1	3	5	7	10	20	30	40	60
LIBBY.										
$\Delta = \pm 8$		94	93	100	100	100	97	89	92	84
	D	100	98	95	100	95	96	93	85	83
$\Delta = \pm 4$		88	74	84	74	83	78	75	76	74
	D	93	85	82	88	85	82	83	78	87
$\Delta = 0$		95	80	70	50	55	30	25	35	10
	D	80	90	15	25	10	5	5	0	5
WILSON.										
$\Delta = \pm 8$		89	90	97	91	95	91	84	80	78
	D	79	91	85	89	90	81	77	78	80
$\Delta = \pm 4$		70	71	51	82	65	64	76	68	68
	D	79	67	68	65	68	73	74	64	60
$\Delta = 0$		95	85	100	93	85	55	57	45	18
	D	80	70	60	63	45	40	25	55	40
ANGELL.										
$\Delta = \pm 8$		91	94	94	84	89	86	88	83	79
	D	94	93	87	94	90	86	88	82	75
$\Delta = \pm 4$		66	72	57	60	60	66	64	49	57
	D	71	42	49	60	67	63	59	44	56
$\Delta = 0$		83	95	89	83	83	78	72	53	31
	D	89	94	58	64	69	53	39	39	42
STEFFENS.										
$\Delta = \pm 8$		58	60	43	63	57	59	60	50	68
	D	66	67	40	73	51	45	61	67	58
$\Delta = \pm 4$		50	41	40	53	50	59	56	64	57
	D	57	50	43	60	47	66	56	48	71
$\Delta = 0$		90	60	35	40	35	5	0	0	5
	D	60	28	25	10	18	8	0	3	5

46: for the last 4 it is 59. L. and W. held an intermediate place between S. and A. in this respect. As far as these results go, therefore, no law can be laid down in regard to a decrease in accuracy of the so-called tone-memory for intervals up to 60 seconds: the most that can be said is that there is a small and irregular falling off for some and no falling off for others. In this respect, then, our results are different from Wolfe's.

On the other hand there is a very marked falling off in accuracy of judgment with increase of time interval for $\Delta = 0$: in the case of S. the percentage of right judgments sinks from 90 for 1 second to practically zero for the longer time intervals. With A., however, the corresponding figures are 83 and 31 respectively, indicating, it would seem, less a marked difference in sensitivity than a marked difference in method of judging. Before proceeding to an analysis of results the writers will add Tables III and IV similar to Tables I and II respectively.

These tables are results of experiments carried out the following year with two new reagents, Mrs. Mary George and Mr. Bullock—as a test of the results in Tables I and II. And here it may be said that both series of experiments were conducted under very favorable circumstances; no other experiments were allowed to go on in the laboratory at the same time; the laboratory building itself was situated in a field with but one occupied building in its vicinity. Finally, the reagents themselves were all earnest and strenuous. The conditions of the

TABLE III.

Second group of Reagents. Symbols as in Table I.

GEORGE.

t.-i		1		3		5		7		10		20		30		40		60		
		D		D		D		D		D		D		D		D		D		
Δ=±8	r	20	20	18	21	20	22	21	19	36	35	52	48	52	43	39	31	38	37	
	w	2	4	3	2	1	1	2	3	3	4	2	8	3	5	6	10	6	8	
	III				1	2	1	1	2	1	1	2	2	1	8	3	7	4	3	
	?	1		1		1														
		23	24	22	24	24	24	24	24	40	40	56	58	56	56	48	48	48	48	total= 687
Δ=±4	r	13	14	19	16	18	16	15	16	42	39	55	54	58	44	45	45	47	52	
	w	6	8	3	6	4	5	5	4	15	19	15	15	21	26	18	16	22	13	
	III	3				2	3	3	3	15	16	17	17	11	18	17	19	10	15	
	?							1	1											
		22	22	22	22	24	24	24	24	72	74	87	86	90	88	80	80	79	80	total=1,000
Δ= 0	r	9	6	10	6	7	5	6	3	15	12	11	10	14	9	15	12	10	12	
	w	3	6	2	6	5	7	6	9	13	16	25	26	22	27	17	20	22	20	
	?																			
		12	12	12	12	12	12	12	12	28	28	36	36	36	36	32	32	32	32	total= 424

Total judgments for G.=1,211

BULLOCK.

t.-i.		1		3		5		7		10		20		30		40		60		
		D		D		D		D		D		D		D		D		D		
Δ=±8	r	17	17	22	16	21	20	19	21	34	27	42	45	50	39	40	37	36	35	
	w	3	1	2	1	2	1	1	3	1	6	10	5	4	11	3	5	11	9	
	III		1		2	1	3	4		5	7	4	5	2		5	5	1	2	
	?		1		1								1				1		3	
		20	20	24	20	24	24	24	24	40	40	56	56	56	50	48	48	48	49	total= 671
Δ=±4	r	17	17	17	18	17	16	16	19	33	31	43	48	59	41	54	40	46	37	
	w	4	3		1	1	4	3	2	12	11	17	15	8	19	12	8	13	14	
	III	1	2	5	3	6	2	5	3	11	13	9	8	5	18	6	13	3	12	
	?						2				1	1	1				3	1	1	
		22	22	22	22	24	24	24	24	56	56	70	72	72	78	72	64	63	64	total= 851
Δ= 0	r	12	10	12	9	8	7	8	6	20	15	16	14	17	17	13	10	13	14	
	w		2		2	4	5	4	6	4	9	16	16	15	14	4	16	14	11	
	?				1											1	2	1	3	
		12	12	12	12	12	12	12	12	24	24	32	30	32	31	28	28	28	28	total= 381

Total judgments for B.=1,903

TABLE IV.

Percentage of right judgments in Table III; about three times as many judgments for intervals from 10 seconds to 60 seconds as for intervals 1 second to 7 seconds.

GEORGE.

t.-i.		1	3	5	7	10	20	30	40	60
$\Delta=\pm 8$		88	84	85	87	90	93	93	81	79
	D	83	87	91	79	87	86	77	65	78
$\Delta=\pm 4$		59	86	79	64	58	63	64	56	60
	D	64	73	66	69	53	63	50	56	65
$\Delta=0$		75	83	58	50	54	30	66	47	31
	D	50	50	42	25	43	28	25	37	37

BULLOCK.

t.-i.		1	3	5	7	10	20	30	40	60
$\Delta=\pm 8$		85	92	87	79	85	75	89	83	75
	D	88	83	83	87	68	81	78	78	75
$\Delta=\pm 4$		77	77	71	67	59	62	82	73	74
	D	77	82	71	79	56	67	52	65	59
$\Delta=0$		100	100	67	67	83	50	43	75	48
	D	83	79	58	50	62	47	55	39	47

experimentation were as in the first group—the reagents being kept in complete ignorance of its course. The chief difference lay in the methods of distraction and in increasing the relative number of judgments for the longer intervals—from two to three times as many judgments being given on the intervals from 10 seconds to 60 seconds as on those from 1 second to 7 seconds.

The results of these experiments corroborate those of the preceding group: as before, in agreement with Wolfe, there is a marked falling off in right judgments with lengthening time for $\Delta=0$:—on the other hand there is no marked and regular falling off with the time for $\Delta=\pm 8$ or $\Delta=\pm 4$. Comparing the longest with the shortest intervals one gets:—

		Average of four intervals 1 sec. to 7 secs.	Average of four intervals 20 secs. to 60 secs.
George	$\Delta=\pm 8$	84	84.5
	$\Delta=\pm 4$	72	60.7
Bullock	$\Delta=\pm 8$	85.7	80.5
	$\Delta=\pm 4$	73	72.7

If G. shows a falling off for the longer intervals with $\Delta=\pm 4$, she shows none for $\Delta=\pm 8$. B. on the other hand shows a falling for the greater difference, but practically is as accurate on the longer interval as on the shorter for the smaller differ-

ence. So far as these results go, there can be no general law of sensory memory.

Even for $\Delta = 0$ the individual variations are far too great to admit of other than the very broad statement that the number of correct judgments decreases with the time interval.

The writers are not able to explain satisfactorily the discrepancy between Wolfe's results and their own. The main difference is perhaps that in Wolfe's work the reagents knew what the value of Δ was which they were judging:—whether it was a difference of 4, 8 or 12 valuations—while in the writers' work none of reagents knew anything in regard to the value of Δ. This difference in the mental attitude of the reagents is reflected in the results, as Wolfe's reagents did not respond to variations in the value of Δ as closely as one would have expected. Wolfe himself is of the opinion that with the greater differences the attention was less strained—whether during the action of the stimuli or during the time interval he does not specify.

Acting at once as reagent and experimenter, Wolfe contributed to his data far more judgments than any other reagent, but we do not find that his general results differ so much from those of the other reagents as to warrant the inference that his knowledge of the course of the experimentation affected the work very differently from the knowledge of the other reagents.

A further difference between Wolfe's method and our own lies in the fact that in our work the number of judgments for $\Delta = 0$, was about $\frac{1}{3}$ of those for $\Delta = \pm 4$, or for $\Delta = \pm 8$, while in the earlier work the number of judgments for $\Delta = 0$ was greater than for the other differences. When one considers the diversity of results produced by different mental attitudes, together with the great difficulty of reproducing accurately all the conditions under which a given set of psychological experiments is made, one is almost tempted to say that it is likeness of result, not unlikeness, which calls for explanation in work of this kind.

As far as the writers' results go, however, there is no question of a loss of sensory memory: the individual variations are so great in both groups of experiments as to indicate that we have to do with certain specific ways of forming judgments rather than with a general way of depending on the presence of a more or less fleeting 'memory image.'

The discussion of the 'memory image' theory in the light of the distraction experiments, together with a consideration of specific ways of forming judgments of like or unlike, will occupy the second part of this paper.

(Part II to follow.)

NOTES ON THE PSYCHIC DEVELOPMENT OF THE YOUNG WHITE RAT.

By WILLARD S. SMALL, Fellow in Psychology, Clark University.

A study of the psychic development of any young animal needs no apology. Apart from the fascination and the self-education of watching the development of any form of life from its early protoplasmic simplicity into complex maturity, there is the solid scientific reason that Genetic Psychology has much to hope from minute and accurate records of the developmental periods of young animals of all species. It may never be possible to reconstruct a complete psychic organism from the evidence of a single trait—an ideal borrowed from morphology—but something surely may be accomplished towards a *comparative embryology* of the soul. What Preyer and others have done for the human infant, needs to be done also for the baby-animal of every species. Prof. Wesley Mills, of Montreal, has already done this for the dog, cat, rabbit, guinea-pig and chick—which latter has also received careful study from Spalding, Morgan, Thorndike, Kline and others.

The present form of this study was suggested to me by Prof. Mills's very interesting and attractive work. I have adopted his method of giving the diary of the first few weeks of the young animal's life, substantially as the notes were jotted down, following this with a general summary of results and some in ferences as to the significance of special features. For this purpose one litter of five rats was carefully observed daily, from birth to the age of four weeks. For study of special points and confirmatory evidence other litters were often used.

From a physiological point of view the developmental period of the human organism[1] falls into two great divisions—before and after puberty—the *ante* and *post urbem conditam* of growth. The pre-pubertal period is childhood. But this again is divided, upon physiological and anatomical grounds, into two periods, infancy (das eigentliche Kindesalter, infantia, enfance) and childhood proper (das Knabenalter, pueritia, jeunesse). Without pausing for the anatomical characters upon which this division is based, it is perhaps a fair statement to say that infancy is the period in the child's life before the neuro-mus-

[1] Vierordt: Gerhardt's Lehrbuch der Kinderkrankheiten, B. I, Ab. I, p. 299.

cular system and the sensory apparatus have reached a stage of development when they function easily and definitely. The period after that, and before puberty, is childhood.

In all the higher mammals, at least, there are analogous periods of development. Doubtless there are wide variations in the distributions of these periods, even between closely allied families as, *e. g.*, the guinea-pig and the rat. The guinea-pig's infancy is almost wholly intra-uterine,—he is born with neuro-muscular and sensory apparatus almost perfectly developed. The rat, on the other hand, does not reach a like degree of development until about the third week of life, or even later.

The diary covers the period of infancy of the white rat, *i. e.*, the period up to the time when the sense organs were working normally, and the muscular movements were all perfectly co-ordinated. The subsequent period has received only casual observation. The summary and inferences have the supplementary evidence of general observations covering a period of nearly two years.

Day 1. The rats at birth are bright red, ugly and helpless little creatures. The average weight is 5 grams. Average length: of body, 4.2 cm.; head, 1.2 cm.; tail, 1.4 cm. The skin is thin and delicate, and absolutely destitute of hair. There is no external ear—only a dermal fold. No external eye—a slight protuberance. The nose is pretty well developed—a spongy-looking bulb, armed with short delicate feelers. The nostrils are completely open, but very small—about ½ mm. in diameter. Mouth is a mere sucking disk. No rudimentary teeth. Their movements, except sucking, are inco-ordinated, yet purposive. Sucking they accomplish lying on their backs and sides, the mother crouching over them. They keep constantly under the mother's body. When held in the hand they roll up in a ball. If placed upon their backs they hitch and kick and wriggle over upon the belly or side. They are generally unable to maintain the belly position for any length of time and fall over upon their sides in a ludicrous manner. When lying upon the belly, they stretch out their paws in a turtle-like way. Move their tails.

I distinguish three vocal efforts: a sort of clucking sound; a fine wire-like squeak (hunger?); and a sort of chirp, short and sharp.

I tested for reactions to smell, taste, and tactual stimuli.

Smell. 5 rats. All sensed violet, as indicated by expressive movements. Reaction, slow—about 15 seconds. One only objected: threw up head and made convulsive movements with fore paws. All showed dislike to cheese, if movement away could be so interpreted. Instantaneous convulsive reaction to HCl.

Taste. Tested with sugar-solution, warm milk, and strong salt solution. These were applied to lips with fine brush. In each case, the rats squeaked and wiped at the offending stuff with fore paws. Movements rather inco-ordinated. The movements are: brushing and pushing away with the fore paws; averting the head; movement of the whole body. In case of the salt solution, the reactions were more vigorous, accompanied by voiding of urine.

Clear water called out the same characteristic reactions.

From this similarity of response, I infer that there is no differentiation of tastes, as pleasant and unpleasant. They are all unpleasant.

Temperature. (a) They are very sensitive to atmospheric changes. Removed from the nest into a temperature of about 45° F., they become torpid; heart-beat becomes markedly slower and fainter. (b) They have temperature sense, though they do not respond to moderately hot or cold stimuli; a hot wire, just below burning point, makes them jump and wriggle within the skin; cold (water) above 40° F., gave no result unless accompanied by pressure.

Pain. They respond with squeaking and struggling to slight pinching.

Tactile Sensibility. They give little response to light pressure, as with a hair—except upon the nose, which seems to be very sensitive. Mass pressure is not noticed unless comparatively strong. All attempts to get response to sound failed—as expected.

Day 2. Repetition of the same measurements showed growth. Ear and eye regions a little more prominent. Seems to be slight advance in sense of smell, for they made no objection to odor of cheese. Other odors elicited same responses as first day.

Day 3. The movements are a little better co-ordinated. Only one of the five showed aversion to violet, and two to clove and asafœtida. Spirits of camphor and pennyroyal brought expressions of disapproval from all. Irritating fluid (HCl.) produced instantaneous responses from all. In addition to the motor reactions, there were vocal expressions and a striking acceleration of respiration. Reactions to the other stimuli were slow, varying from 10 to 50 seconds.

Day 4. The skin begins to whiten a little. Dermal sensibility seems about the same. Movements are better co-ordinated. When placed upon their backs, they turn over much more quickly and surely. Maintain position upon the belly. Are able to crawl a little, and to raise the head higher and longer than yesterday. They constantly utter short metallic squeaks and the clucking noises, during these efforts to recover equilibrium and orientation—for I take these attempts to raise themselves to be the prophecy of the orienting process. They huddle together—trying to crawl under each other. They make an animated pile. This is a characteristic habit of the rat throughout life. A company of rats will always pile up in a dense heap except in the warmest weather.

Smell. Reactions to violet, camphor, pennyroyal and clove, show less aversion; those to asafœtida are quicker and show more dislike. In four cases out of five there seemed to be a pleasurable response to cheese-odor—in one case accompanied by what sounded like a pleased squeak. The fifth one paid no attention. In case of camphor and pennyroyal, it was easy to distinguish between the act of sensing the odor and the affective response. They sensed pennyroyal quickly—about 5 secs.—sniffed with deep respiration—then slowly averted the head.

Day 5. Much stronger. Turn over almost instantly when placed upon back. Crawl with considerable vigor.

It begins to be apparent that the clucking sound spoken of several times before, is the beginning of a squeak—other than the one they make in the nest when hungry and which they make from birth. This new squeak is solider in timbre—a short, sharp, metallic click—something like the chirp of a sleepy chicken. It is evidently a sign of pain or discomfort. The other seems to indicate hunger.

Nothing new in regard to the special senses.

When returned to the cage they began immediately to crawl about in a lively manner. This is an infant prophecy of that restless curiosity which is so prominent a characteristic in the rat nature.

Day 7. Weight, 8.8 gr. A gain of 3.8 gr. Length: body, 6 cm.; head,

1.7 cm.; tail, 2.5 cm. The skin is now plainly covered with tiny white hairs. The ears, eyes and nose show commensurate progress. The pinnæ are 3 mm. in length; the invagination of the meatus begins to show. The membrane over the eye-bulbs is white, but shows a dark line where the separation of the lids is to be. There are a few brow-hairs started. The nostrils have doubled in diameter. Feelers have more than doubled in length.

When placed upon their backs, they instantly turn over. Rest quite firmly upon their limbs, which are spread out in a turtle-like manner. Crawl vigorously.

Dermal sensibility becomes more acute, though susceptibility to pressure is still greater on the nose than elsewhere on the body. Especially, greater when tickling is involved. A bristle drawn across the body elicits scarcely any response; but applied with the same pressure to the nose, evokes squeaking and vigorous head-shaking. When the toes are touched the rats squeak and jump so as to lift the body nearly off the floor. One, thus insulted, crawled away two inches. There seems to be a slight intensification of the reactions to painful stimuli. I notice occasional convulsive leaps which have no apparent external cause. The tests for smell seem to show a growing indifference to all but the positively painful stimuli—irritating fluids, *e. g.*, HCl.

Day 8. Crawl vigorously. They almost crawled out of my hand before I realized what they were doing. In constant motion while on the table.

The nostrils begin to take on the pear-shape. Lower teeth can be seen in the gum, but are not cut.

When crawling about the table they show some selection of path, sniffing and going in different directions.

They seek constantly to get close together, each striving to get under the rest for warmth. This action is very striking.

Two crawled to the edge of the table, but stopped and then crawled away. Another one got too near, lost his balance and fell over. Another went to the edge and remained there with his head just over. This looks like a sensing of danger.

Reactions to odors become more individual. On the whole they tend to become indifferent. Glacial acetic acid and carbolic acid gave negative reactions.

Day 9. Pinnæ are 4 mm. long. Meatus deepening. Covering membrane of the eyes is now very thin, and shows dark purple in contrast with the surrounding white-haired region.

The motor activities are stronger. They move forwards, backwards, and sideways. Climb into a heap. One crawled more than a foot, stopped, hesitated and finally came back. They sniff constantly at everything. They crawled out of the nest after the mother had put them in. Saw one seeking purposively for her teats.

Day 10. Nostril is now perfectly pear-shaped. Feelers about 1 cm. in length. Mouth is assuming the adult form—the upper lip has the deep sinus.

Activities are stronger, better co-ordinated and more constant.

Special senses show no new features.

Day 11. Meatus-indentation shows corrugation.

Day 12. Lower teeth are cut.

Mother was at opposite side of the cage from the nest. One of the young ones crawled across to her and began to suck. He seemed to have a definite purpose. Later I saw the same one trying to crawl up the perpendicular side of the cage—wood covered with wire mesh. Got up about three inches before falling. A few minutes later he climbed

upon his mother's back. (N. B. Eyes not open.) They *walk* now, though rather unsteadily. By using both fore and hind feet they held to my hand a moment when I suddenly turned my hand half over. They also crawled out of my hand when it was gently closed upon them. A very characteristic action. Rats always squeeze through crevices if confined. I saw one washing his face—the real thing. Licked the paws and then carried them over the face. Repeated half a dozen times. Movements are not very well co-ordinated. Three crawled to the edge of the table, stopped, reached over as far as possible without falling, throwing up the head and sniffing in the very characteristic way of rats when orienting themselves, and then retreated. One leaned a little too far over, and fell, but caught the edge with fore paws and hung a moment till I saved him.

Dermal sensibility considerably heightened. One jumped violently when touched with the sharp corner of a piece of paper. Flanks, sides, back and feet are equally sensitive. (Possibly fright accounts for this violent reaction. But why fright, unless there is increased sensibility?)

Day 14. Weight, 14.8 gr. Length: body, 7.1 cm.; head, 2.2 cm.; tail, 3.9 cm. The pinnæ are about 6 mm. in length; the conch is pretty well formed, and about 2 mm. deep. Ears and eyes appear ready to open. Feelers are 1.5 cm. long. The upper teeth are cut. The body is covered with hair about 3 mm. long on back and sides; shorter on the belly and legs. Ears and tail quite bare.

They run about the cage and over the mother's back. Climb over considerable obstacles. One got down from a block two inches high without falling. Hold on to the finger a second when turned upside down. All wash their faces industriously. When moved to a new place they go through the peculiar orienting movements of rising upon hind legs (as far as their deficient strength permits), lifting their heads and sniffing. They show the same proneness to pile up in a heap, when left loose upon the table. I notice also the convulsive starts, with no apparent external stimulus.

Sensibility is heightened, as indicated by convulsive reactions to tickling and light pricking. They sense odors at a much greater distance now. The same actions when they come to the edge of the table.

In their appearance and actions they now begin to answer to Dehne's characterization of "lieblichste Thierchen."

Day 15. Ear appears perfect, but is not open yet. So the eye.

They wash their faces frequently. Saw one scratch the back of his head and face with his hind foot. Romanes says this action is a pure reflex.[1] These movements were all perfectly co-ordinated. While I was weighing them, one fell out of the scale pan. He caught the edge as he went over and hung by his fore paws for more than a minute, struggling to get back, which he nearly succeeded in doing. A great increase in strength.

One of the rats crawled from the top of one cage down to another two inches below. The top of the first cage was walled in on two sides by glass sides, but at the corner where they met was an aperture about one inch wide.

The rat was crawling along the top of the box close to the glass side. When he came to the end he poked his nose through the aperture, discovered the descent, leaned far out and sniffed; tried to retreat, but, finding this difficult, sniffed carefully down the side, then went down without falling. Crawled an inch or two on the top of this cage,

[1] Darwin and after Darwin. Part II, p. 80.

then turned and came back the same way, climbing up over the first cage. (It is to be remembered that the rat's eyes were not open at this time.) The mental movement involved is not easy to interpret. One might speculate profusely. Whatever may have been the cause of his turning back, it seems probable that he took the straight path back by scenting his own trail.

Day 16. Ears and eyes not yet open.[1] The mother has roofed over the nest, and has a small hole for exit and entrance. I saw one of the young one's nose around until he found the hole and then crawl out. They can cling to the finger more than a minute when held upside down. They give no sign of fear when I handle them. They lie in my hand perfectly content.

Day 17. All have ears open and the eyes of all but one are wholly or partially open. (The eyes and ears of another litter opened on the fifteenth day.) This simultaneous opening of two new sense avenues must mark a crisis in the life of the rat. The voluntary motor activities noted are: crawling all over the mother while in the nest; frequent face-washing; occasional scratching of the head with hind foot; one nibbled at my finger as I held him in my hand; one crawled hastily out of the nest when I put my hand in to get them.

When being weighed, they crawled to the edge of the scale pan and peered over, but did not try to get out. I notice distinct tail movements. They now lie contentedly in a compact row instead of piling up indiscriminately. I am led to ask whether these huddling movements are not the first expression of the social instinct (after sucking and seeking the mother's belly for warmth). If so the desire for warmth is *a* primitive root of the social consciousness.

The rats now walk firmly and orient themselves quickly. I saw one chewing for several minutes, as if sucking or trying to swallow, as he lay half asleep. Is it a reflex exercise anticipating mastication? A play?

Sensation. Hearing. The bursting of a bag three feet away caused them to jump quite out of the nest. Later, clapping hands sharply at a distance of 10 feet caused the quick recoil peculiar to rats. Did not run. A sharp "sh" at 3 ft. brought their heads up. Word "rats" in a low tone at 1 foot, caused a slight jump. Rustling of paper produced the same result. Whistling brought up the head as if listening. Even at the very dawn of ear-consciousness there seem to be differences of emotional reaction to different elements in the "big buzzing confusion" around them. Every concussion elicits a startled movement; the gentle, prolonged note, *e. g.*, whistle, on the contrary, produces a reaction indicative of unscared attention.

Sight. When brought into a strong light they did not wink or show uneasiness, though they soon closed their eyes, and seemed to become drowsy. A stroke of the hand one inch in front of the face caused winking and a slight recoil of the head.

Smell. Recoiled quickly from camphor. Moved quickly toward brown-bread, dog-biscuit, and honey held at a distance of one inch. Appeared not to dislike iodoform or wintergreen.

Taste. One ate honey when a drop was put into his mouth. Tried to gnaw brown-bread when a crumb was put into his mouth. After that when the brown-bread came within smelling range he would go towards it. Chewed a tiny piece, holding it in his paws in a well-bred rat's way. I gave a little piece to another one. He took it in both paws and chewed it. The others scented it and tried to help, but he

[1] Another litter, having the eyes open already on the sixteenth day, lapped milk from my finger after having been given a taste of it.

quickly drew away with his treasure. There seems to be an immediate association between smell and taste. Though not conclusive, the evidence points that way. Another one declined to eat sealing-wax after smelling it, and spat it out when a piece was put into his mouth.

Emotion. They show fear, as before stated, when touched suddenly; also at a loud concussion. I cannot see that they have any fear of me, certainly not from smelling me. They looked happy when eating brown-bread.

Day 18. Eyes of all fully open. All the movements are stronger and are pretty well co-ordinated. They are sprightly and characteristically restless. They sit up well on their hind legs, using the tail for support, and wash their faces vigorously, passing the paws quite to the top of the head. (N. B., the first washings were almost farcical—the paws often not touching the face more than one stroke out of three.) One licked and gnawed at my hand as he sat in it. I put my finger near his nose. He sat up, took it in his fore paws and chewed at it.

They constantly run about the cage and cause the mother great anxiety by getting out of the nest after she puts them in. I saw them hiding, apparently, in the loose excelsior of the nest. This is the first thing I have seen that looks like play. They crawl all over the mother.

Their sense of equilibrium is pretty good. One crawled from one scale pan across to the other. The distance is about 2 inches, and the bridge not more than ¼ inch wide; and the two parts were oscillating at that. Yet he made the journey safely.

They begin to show the characteristic curiosity of rats—investigating with the nose everything they can reach. They jump occasionally without apparent stimulus.

I saw one licking another's face. Probably a play activity? Or it may be an instinctive outcrop of that reciprocal service of washing or vermin catching which rats perform so habitually.

Sensation. Hearing, acute. Convulsive movements follow clucking, "sh"-ing, clapping of hands and other sudden noises. Whistling causes only wiggling of ears.

Sight. Wink when any object is brought close to their eyes. When in a strong light they soon become drowsy.

Smell. Sensed moistened dog-biscuit at 4 inches. Sniffed at pure cologne water. This odor seemed to disturb them for they crawled about nervously for several minutes.

Taste. They chewed bits of moistened dog-biscuit with evident relish. Seemed to like sugar, but did not touch it until it was put into their mouths. The grittiness disconcerted them a little, but the pleasure of the taste seemed to compensate. Salt did not cause much disgust.

Emotion. They show fear at unusual noises. No fear of me. They lie contentedly on my hand, and are not afraid when I take them up. Stroking their heads has a soothing effect. They seem to get the greatest satisfaction from lying huddled together.

Day 19. Incessant activity after 4 P. M. Play with the excelsior of the nest; run over the mother and each other.

Gnawed at a big piece of dry dog-biscuit when I fed the mother.

They are still absolutely fearless with respect to me.

Day 21. Weight, 18 gr. Length: body, 8 cm.; head, 2.5 cm.; tail, 5 cm. In 3 weeks they have nearly quadrupled in weight, and doubled in length of body—tail quadrupled—head doubled. The mother escaped from the cage last night, so the young ones have not been suckled to-day. They huddled together quietly most of the day, but towards night

began to run about and play. I saw one drinking at the water jar. All ate hard biscuit, and lapped milk from a little jar as they sat in my hand.

Whenever I go near the cage they stretch up their heads and sniff all about. I put my hand into the cage, near the nest, and they all crawled into it and licked and nibbled my fingers. Not the slightest sign of fear.

They now go all over the cage—up the sides and crawl on the roof, belly upward. One went from the outside top of the cage down into the inside—a feat requiring very perfect muscular co-ordination.

They still prefer mother's milk to artificial food, as indicated by insistence on sucking the moment she returned to the cage.

They begin to chase and pommel each other. Saw one tugging at the tail of another.

Day 22. The sense organs are now perfectly developed. There is merely a continuous growth. Feelers, 2.5 cm. Hair varies from about 1 cm. on the back to less than 1 mm. on the ears and tail.

Activities. They play almost constantly while awake. Climb upon the mother and playfully bite her ears. Wash themselves a great deal. Are very neat. Wash the whole body and bite the toe nails. I saw one, this morning, digging very vigorously at the corner of the cage. He had dug away all the sawdust for the space of an inch. According to Groos's interpretation this would be a play activity. It would be interesting to know whether the rat was *trying to dig out* or *was merely digging.*

Emotion. Still show no fear of me. They crawl fearlessly into my hand and thence over my coat. One crawled from my shoulder into my pocket and remained there. Fear in connection with loud noises is more definitely determinable: besides the reflex recoil, they crouch and huddle together and wear a subdued expression.

Their curiosity is inordinate. It seems greatly to predominate over fear—in striking contrast with the adults where the balance is pretty evenly preserved.

They come towards me whenever I open the cage. I am not quite sure whether they see me approaching, but I think they do.

They sleep most of the day, and still suck a good deal.

Advancing intelligence was marked to-day by a rat's pushing a comrade away from the dish of milk. The stimulus to this action might have been the odor or it might have been seeing the other fellow drink. The movement was very effective. Intelligence in this case at least is a "means to nutrition."

Day 23. The plays become a little more definite. The rats nip each other's tails, ears and feet. No real scrimmages as yet. They also lick each other—as if affectionately fondling each other.

The mother was returned to the cage after an absence of 24 hours. The little ones all left a dish of warm milk and hastened to suck. They exhibited the greatest satisfaction in the change.

Something to-day that looked like imitation. The mother was sitting in the nest, pulling excelsior towards her to build up the nest. One of the little fellows suddenly began doing the same thing. Stopped when the mother stopped.

They also began trying their teeth on the wood of the cage to-day.

Day 24. They now struggle for food. Begin to show the greedy eagerness which is a marked characteristic of the adult rat. I saw one scuffling with the mother for a piece of biscuit.

One ran and hid behind the mother when I put my hand into the cage. I have not seen, before this, any show of fear at the sight of my hand—or was it play—mere pretence?

They have fierce sham fights, tumbling, rolling and leaping about, but I have not seen any display of anger. They come to the window when I tap on it; and stand in attentive attitude after the reflex recoil at the sound. They dig into the corners of the cage a great deal. I also observe them "picking" the mother and each other a great deal. This seems to be recognized as a reciprocal office, for they sit quietly while it is being performed. Vermin?

Day 25. Play is very vigorous. They frequently start and leap without the least external stimulus—apparently the mere discharge of superabundant motor impulse. Frantic rushes up the side of the cage. They fight beautifully for food, but no sign of anger.

Day 28. The rats are very active. They play incessantly while awake. At this stage they are veritably "lieblichste Thierchen"—most fascinating little creatures. Their rapidity of movement is marvellous. The plays certainly cover a great many of the serious activities of adult life—including those of sex. They show no striking fear of me yet. Occasionally they run away after sniffing my hands, but this seems to be as much in sport as in fear.

Remarks on the Diary.

Prof. Mills, in his remarks upon the psychic development of his puppies, says: "The facts most striking in the first few days of life are the frequent desire to suck, the perfect ability to reach the teats of the dam just after birth, the misery evident under cold and hunger, and the fact that the greater part of existence is spent in the sleeping state." This statement is equally true of the young rats, if we add the facts of their rapid growth and change from the larval appearance, and of their vocal accomplishments. The desire for warmth and the desire for food seem to be their very first psychic experiences in life; the former preceding in time and being more imperative. A special significance of this fact will be noted later.

Sucking. Prof. Mills discusses fully the first character of this reaction, and concludes that it is not a "congenitally perfect or instinctive action" as the "sucking is not perfect at first," but "is improved with practice." My observations upon the young rats accord perfectly with the conclusions of Prof. Mills. The young rats find the teats largely by accident, aided by the mother who pushes and pulls them under her. I have not seen them attempt to suck other parts of the mother's body—the fur, *e. g.*,—as did Prof. Mills's puppies.[1] I am also of the opinion that smell plays no very important part in finding the teats at this early period. It is rather that they are attracted by the warmth of the mother's belly and find the teats accidentally.

Sensation. The infancy of the rat falls naturally into two distinct divisions: the period before the opening of the eyes and ears, and the period following this event. As noted in the diary the ears and eyes open almost simultaneously, from the

[1] Since writing this sentence I have seen a six-days-old rat sucking the mother's fur.

fifteenth to the seventeenth day. Before that time, taste, smell, the dermal and tactile groups, and the organic sensations are present.

Pain. The young rats experience pain from the very first—a slight pinch or prick or extreme heat bring out pain reactions. If one may judge, however, from the relative violence of reactions, sensitiveness to pain is much less acute at first than later.

Taste. The experiments seem to show that there is little or no discrimination of tastes at first. The reactions indicate that all tastes, except the taste of mother's milk, are disagreeable—some more than others, of course. It is possible that taste, properly speaking, is absent at first, and that the temperature, and the chemical and mechanical effects of the substances determine the reactions. The apparent disagreeableness of so many substances lends color to this supposition. Experience of sensations inherently pleasurable may be needed to neutralize the disagreeableness of the primitive shock.

Smell. Though taste and smell are intimately connected, it is comparatively easy to eliminate the taste element from the experiments on smell. It is certain that the young rats can sense odors immediately. The strong irritating fluids like HCl. produce, of course, a direct chemical effect upon the mucous membrane. This is positively painful, and the reaction may be regarded as the indication of a pure pain sensation, in spite of the genuine odor-element in this stimulus; but the reactions to other odors which are quite free from the irritating element prove beyond a doubt that the pure sense of smell is present at this early period. Whether there is discrimination of smells at first is doubtful. When three or four hours old the rats react from violet and cheese in about the same way, indicating that all odors are disagreeable at this time. This state continues for a day or two; then the rats begin to show discrimination. They turn away from some odors as if in disgust, approach others with something like satisfaction, and are apparently quite indifferent to others. This character of indifference extends to a larger field of odors as the rats get older. It is easy to distinguish between the act of sensing the odor and the affective reaction, though at first this is less easy. In the case of irritating fluids such discrimination is impossible, for the reaction to the stimulus is instaneous. With pure odors, however, even from the first there are movements,—adjusting the head and sniffing—indicative of sensing, which precede the movements expressive of pleasure or disgust. After the first few days the careful sensing of the odor before the affective reaction is clearly marked.

These facts are what might be expected from the anatomical character of the olfactory apparatus. The nose and olfactory

lobes are well developed at birth; but there is every reason to believe that the psychic results of this first functioning must be of a very general character. The machinery is all ready, but, like any other piece of new machinery, it needs use and oil in order to attain its maximum efficiency.

There seem to be considerable individual differences in regard to the smell sense at this early period. Some manifest indifference to most odors much earlier and more definitely than others.

As the sense of smell is the rat's psychical organ in food getting, we should expect to find the young rats developing the sense in the following order: (1) the initial stage of extreme sensitiveness, when all olfactory stimulations are displeasurable; (2) an intermediate stage, when all but positively detrimental stimulations are indifferent; (3) a period when there is developed discrimination of those odors associated with food from those not so associated. As a matter of fact, there is some such order as this. The stages are not marked, of course, by hard and fast lines; but the evolution from the first undifferentiated nose-consciousness to the point where food-stuffs and odors are definitely associated shows these phases. The process, however, is not entirely one of experimental association, through taste. The young rats show interest in the odors of cheese and milk, *e. g.*, long before they have tasted them.[1] On the other hand they are indifferent and even averse to the odors of many substances without ever tasting them. This selective faculty must be referred to the inherent character of the rat's nervous substance out of which is developed this psychic faculty by normal functioning.

One other question with regard to smell is suggested: have rats any pleasure in odors apart from their association with food? do odors arouse in them purely æsthetic feelings? There is no *a priori* objection to this supposition. It is well known that rats have an æsthetic sense with respect to hearing. I am convinced, too, that rats manifest curiosity apart from that curiosity which is directly associated with nutrition and reproduction. The analogies of these faculties are favorable to the view. Furthermore there is no valid objection from a strictly selectionist point of view, as the mere euphoria resulting from æsthetic olfactory sensations would certainly have a salutary influence in the vital struggle. Of positive evidence there is little. Darwin says that "rats are attracted by certain essential oils," but gives no hint as to the particular oils which have this power of attraction, so we do not know whether they

[1] The odor and taste of cold cow's milk are not identical with those of warm rat's milk.

are food-oils or otherwise. My own experiments have given no definite results either way.

DERMAL SENSATIONS. The young rats, from the first, respond to tactual stimuli. The temperature sense is well marked at birth. I am not so certain about the special tactile sensations.

Temperature. The temperature sense must not be confused with sensitiveness to atmospheric temperature. The psychosis in the latter case is a result of the condition of the whole organism, in which the vital processes are retarded and sensations of general organic discomfort are felt. The temperature sense is, of course, a dermal function merely, and is local in its scope. At birth, a hot substance, just below the burning point, produces a quick reaction; likewise any cold substance at about the freezing point.[1] Between these two extremes, I could get little or no reaction to temperature stimuli. It is impossible to test this sense after hirsutation, so I do not know whether there is an increase or decrease of acuteness. Sensitiveness to cold, however, decreases in ratio to hirsutation, though the white rats can never endure a low temperature.

Pressure, Tickling, and Mere Contact. These factors are too closely connected to permit separate consideration. At birth, light pressure, unaccompanied by motion, produces no reaction, especially if the pressure be exerted with a small body. Comparatively light mass-pressure elicits reaction. So far as I have been able to see, mere contact does not. Tickling, by drawing a hair over the body, produces little effect—often none at all if the pressure element is eliminated, but the same stimulus applied to the part of the nose where the feelers are, elicits a decided negative response. The acuteness of this group of sensations increases *pari passu* with the advance of hirsutation.

EQUILIBRIUM, SENSE OF SUPPORT, AND ORIENTATION. *Equilibrium.* The young rats from birth have a rudimentary sense of equilibrium. All their movements, inco-ordinated and ineffective as they are, show a preference for the belly position. If placed in any other position they strive to regain this one, and are not comfortable until they get it. (An exception to this is, of course, the tendency to lie upon the back when sucking, but that is a special office demanding special position.) The neuro-muscular mechanism, however, is so imperfectly developed at this period that effort is required constantly to maintain the normal position. By the end of the first week they are able to equilibrate pretty well, and before the end of the third week they maintain their balance under the most

[1] There is a possibility that what seems to be temperature sensation is pain sensation—but the temperatures tried are well within the normal limits. It cannot be mere contact, for similar contact at mean temperatures effected no reactions.

trying circumstances. I have made no tests to determine their susceptibility to dizziness, but have no reason to doubt that it is present from the start.

Orientation. This view of dizziness finds some support in the fact that they orient themselves with respect to up and down from the very first. I have not made any test to determine at what least angle they turn the head to the upward inclination, but certainly they do so at 30°. The adjustment is comparatively slow at first, but becomes instantaneous before many days.

I am of the opinion that there is a rudiment of lateral space orientation from the first. The new-born rats when placed on their backs struggle over on to their bellies. With the normally strong rats this effort is generally succeeded by an attempt to rise upon the legs. At the same time the head is stretched upward. Now this is the incipient stage of the characteristic orientation movement of the adult rat—rising upon hind legs with the tail as extra support, describing a circular movement with the head and sniffing all the time. As early as the fourth day these movements began to take on some definiteness, and by the seventh day they are associated with the selection of path and the avoidance of obstacles when the rats were crawling about. In view of the relatively unimportant part that sight plays in the life of the white rat—and probably of the rat in general—the relatively perfect orientatation in this way, long before the opening of the eyes and ears, is significant. As recorded in the diary a rat on the 11th day crawled directly across the cage to the mother—a distance of eight inches, and began to suck. This was six days before his eyes were open; and on the 15th day, two days before the eyes were open, one performed the difficult feat recorded on page 84. Now, as the same movements are used in orientation after the eyes and ears are opened, as before, one is led to conclude that the influence of the eye in the orienting process is very slight. The neural paths which are blazed out in this pre-visual state are the paths that continue to be used. If this is true it suggests two important principles in the study of comparative psychology—even when made experimentally, viz.: (1) the necessity of knowing your animal before you try to enter into experimental conversation with him; and (2) the immense differences in mental processes between not only the lower animals and man, but equally between different animals. The difference between the eye orientation of man and the nose orientation of the rat is not more specific than is that between lynx and rat.

Sense of Support. This phrase is suggested by Mills and commended by Morgan. Mills uses it to describe the sensation which land animals feel when they are deprived of a solid foun-

dation,—as, *e. g.*, when his puppy or kitten stops and shows uneasiness at the edge of a table. Mills thinks this sense is peculiar to land animals, and is congenital—a character which has been acquired since leaving aquatic life. The amphibious turtle, he remarks, will walk right off a table without any apparent sense of the difference of medium.[1] All young land animals, on the contrary, show hesitation when they approach a void; and even though they may be going too fast to stop, they yet make an effort to save themselves. Prof. Mills does not, of course, regard this as a simple sensation—but rather a feeling-complex of various dermal and organic elements. I do not see why it is not a lower stratum of acro-phobia (the fearof falling). My observation of the young rats is confirmatory of Prof. Mills's view. As early as the second day they show an uneasiness when on the edge of a void—sometimes drawing back, sometimes manifesting their dominant trait of curiosity by leaning over and sniffing. At the age of four or five days the presence of this sense is unmistakable, and is not due to experience, as I have found by trying rats that have had no such experience. I had noticed this phenomenon before reading Prof. Mills's remarks on this subject. His interpretation seems to be more satisfactory than anything I had thought of, though, as he himself points out, the case is not completely made out.

Sight and Hearing. The eyes and ears begin to function the fifteenth to seventeenth day, different litters presenting this range of variation. The individuals of the same litter also present variations of several hours in some cases. (Every factor in this development-history seems to emphasize the frequency and range of congenital variation.) At birth there is no external ear—only a dermal fold—the incipient pinnæ. This begins to unfold from the front backwards about the second day and is at first semicircular in form. It attains its perfect form and a length of 6 or 7 mm. just before the meatus opens. The meatus indentation is seen first about the eighth day and assumes its perfect form at the same time as the pinnæ. The growth of the eye is analogous. All attempts to get reactions to sound or light before the opening of the ears and eyes failed. Even a powerful concussion near the ears was effectless. I regret to say that I did not try the effect of a powerful light close upon the unopened lids.

Sight. The question of what the young rats see is complicated by the question of what the adults see. The actions of the adult rats seem to indicate that they see motions rather than objects. I do not mean that they do not have images of objects, but rather that the images of motionless objects have

[1] But will a land tortoise?

little compelling power upon their attention. They follow a moving object with their eyes at a distance of several feet, but they always make their investigations of motionless objects with their noses. I made tests upon the young rats a few hours after the opening of their eyes. They showed some slight discomfort in a strong light, soon closed their lids and seemed drowsy. Throughout life, the white rats show a decided aversion to strong light. I infer from this fact, and the special signs of discomfort, that the first light stimulus is positively painful. The limit of vision is restricted at first. The eyes do not follow a moving object even at a distance of a few inches, and a winking reflex cannot be produced without almost touching the eye. The inference is pretty clear that the first eye-sensations are brightness-sensations and that the eye requires time to adjust itself to the new conditions; in a word, it is not functionally perfect, though it may be anatomically perfect.

Hearing. The ear is hyperæsthesic at first. All sounds—even very slight ones—elicit rather exaggerated responses. The bursting of a paper bag and the clapping of hands at a distance of ten feet, and the gentle rustling of paper at one foot, produced strongly marked reactions.

The rats discriminate between sounds, however, at this time. For instance, a gentle and prolonged whistle produced only a lifting of the head, as of attentive listening, whereas the hissing syllable "sh" caused terrified leaping. It is impossible to say whether there is complete discrimination between tones and noises, but all concussions call out the reflex jumping. I am of the opinion that intensity is more important than quality, at this time, in determining the reaction. Nevertheless, the observed facts in regard to the musical sense of rats and other varieties of the *muridæ*, prove that intensity is not the only factor determining their likes and dislikes. Not only have they a well developed æsthetic sense in respect to tone, but they also regard quality as well as intensity. It may be, therefore, that there is in this case, qualitative discrimination *ab initio*—or as soon as the "big buzzing confusion" has subsided a little.[1]

As smell is the rat's psychical organ of food-getting, so is

[1] This is a point which I have not studied carefully. Yet it is important, for it opens up the whole question of the æsthetic nature of the sub-human species. The data upon this subject are abundant but anecdotal. An ontogenetic experimental study of the musical sense of a few of our common animals could not fail to let in light upon the meaning of the æsthetic sense. The Darwinian interpretation seems inadequate. Sexual selection does not account for all the facts. Prof. Everett's suggestion as to the selective value of mirth, as a promotor of well-being, and hence an aid in the struggle for survival, may be applicable to this question as well.

hearing his psychical organ of defence. The initial hyperæsthesia of hearing means simply that the organism responds reflexly to these unwonted stimuli. It is instructive to note that at first these reflex recoils seem to produce little psychic effect (either perceptional or emotional). There is a motor explosion, and almost instantly the rat resumes his wonted attitude and occupation. Gradually, though rapidly, there is a change in all this, and the reflex recoils are followed by attitudes denoting fear or attention. The attentive attitude is very like that noted at first in response to whistling—the head lifted, etc. The fear-attitude is easily recognized. Later, other emotional states appear, concomitant with auditory stimulation. This indicates a rapid integration and functioning of the higher centers and the associative tracts, which at first are not functionally perfect. It is an analogous case with that of the sense of smell—with the difference of the post-natal anatomical perfecting of the auditory apparatus.

INSTINCTIVE ACTIVITIES. I shall confine my remarks upon this point, to a discussion of the question whether instinctive activities are congenitally perfect. This question, however, has been involved in so much confused and confusing dogmatism and speculation that I must pause to state clearly the limits of the question. Much of the dust stirred up by the various champions might have been avoided had these champions been clearer of their own meaning. The first and most necessary delimitation is to separate sharply the field of instinctive activities from that hypostatic entity known as instinct. This is seldom done; and, indeed, for some purposes it is unnecessary. Prof. Groos, *e. g.*, writing of Play, first elaborates a metaphysical notion of instinct, basing it upon a natural selection teleology; he then forces into an *omnium gatherum* all the voluntary movements of young animals and calls them plays; and then informs us that play is an instinct. Prof. James likewise includes under his category of instinct a quite heterogeneous group of psychic characters. For purposes of teleology and classification this procedure is very well. On the other hand, in a genetic study of instinctive activities the mind must be rigorously on guard against the intrusion of this metaphysical concept of instinct. The necessity for this will be apparent when we consider that two such remotely related phenomena as fear and the bridal flight of the bee are equally "illustrations of instinct." For the purposes of psychological inquiry, the only assumption we need to borrow from this hypostasis of instinct is that of its non-experiential character. All agree that an instinctive activity is one that is performed by an organism without previous experience. In psycho-physical terms, it is the impulse, the effort of an organism to act, with-

out previous experience, in a certain, definite, purposive way, under certain definite conditions. The range is therefore very great. But as "impulse and effort of an organism" are actualized only in motor terms, the instinctive activity is also conditioned by the neuro-muscular mechanism. A tentative definition might be then: an organic impulse, effecting through the neuro-muscular system, definite, purposive, motor ends. The question of the congenital perfectness of the instinctive activities is, therefore, a question of the functional perfectness of the neuro-muscular system at birth. If the neuro-muscular system is so co-ordinated and determined as to realize immediately and certainly the behest of the organic impulse, then the instinctive activity is congenitally perfect; otherwise, not. This means that in most cases instinctive activities are not congenitally perfect. Almost always the perfect instinctive activity is the congenital *set* of the organism *plus* the accuracy and definiteness of movement gained by exercise of the function.

In this view the young rat exhibits almost no congenitally perfect instinctive activities. Crying, which begins at birth, seems to be an indisputable case; also the sucking-reflex—not the complex of movements involved in sucking. All the other activities are inco-ordinated at first, whether manifested immediately after birth or only at a later time. I have set down the following as clear cases of instinctive activity under the provisional definition: Sucking, swallowing, chewing, crawling, clinging, climbing, digging, gnawing, washing, scratching (with hind foot), running, leaping, sex-movements (in play), and, possibly, the "picking" and licking noted in the diary. None of these are capable of immediate and perfect action at birth; some do not appear until several days or weeks after birth; yet all are clearly organic impulses in origin. Several may be called pure reflexes, but the evidence is not clear except in the case of sucking.[1] The face washing is an instructive example. The neuro-muscular mechanism necessary for this act is approximately perfect at birth, as proved by

[1] Prof. Romanes's attempt to prove that scratching with the hind feet is a pure reflex is inconclusive. His method was to amputate the hind feet of his subjects soon after birth, before the appearance of the activity in question. He found that the movements were performed in due time by the mutilated rats just as by the normals, though they were perfectly ineffective. The stump was merely waved in the air, never once touching the irritated spot. This demonstration is imperfect for he did not carry his experiments far enough to determine whether the rats would learn, in time, the uselessness of the movements and cease making them. Moreover, in order to make this demonstration analogous with that of the reflex frog, it would be necessary to find some way of *psychically* decapitating the rat, while leaving the spinal cord intact.

the vigorous brushing movements when a disagreeable olfactory stimulus is applied; but the first attempts at face washing I have noticed—and I have observed several litters with respect to this point—are not earlier than the tenth day. The other instinctive activities readily lend themselves to similar analysis.

Huddling. One of the most striking and characteristic activities of the young rats is that of huddling and piling up together. Of course this is a manifestation of the need of the organism for warmth. That indeed is their first need. They can endure a day of fasting much better than they can endure an hour of existence in a temperature of 40°. After birth they are immediately drawn under the mother's abdomen, where they are kept in a comparatively high temperature. Whenever the mother is removed or they are themselves taken from the nest, they immediately seek to pile up in a compact heap.

I am led to ask whether this is not one of the roots of the social instinct. I think it is by no means a new idea that the desire for warmth has been a factor in socialization; so there is no heterodoxy in the suggestion. This constant desire—imperative need—for warmth, drawing the animals into such intimate physical contact cannot fail to provide a basic social bond. As a matter of fact the adult animals retain the habit. Except in the very warmest weather a cage full of rats will always be found in a compact heap when at rest.

Play. The first distinct case of play I have noticed occurred on the eighteenth day, when I saw the young rats apparently hiding from each other in the excelsior of the nest; but before that time, there were anticipations of play activities in climbing, running, gnawing, etc. The development of the play activities was exceedingly rapid after this first case. On the nineteenth they were running constantly about the cage, climbing over each other and making occasional sallies at the loose excelsior. On the twentieth, they were chasing each other and I saw one tugging at another's tail. On the twenty-second, I saw them biting each other in play. By the twenty-fifth, their whole repertory of plays was complete: running, jumping, climbing, fierce sham fights (no anger ever), with biting, clawing and pommeling, running over the mother and biting her ears, digging in corners, gnawing at the cage, sex-motions, "picking," licking and fondling each other. Most of their playing is violent—frantic dashes up the sides of the cage, sudden leaps into the air, violent assaults upon each other. I have not made out whether all the play activities are definitely anticipatory—according to Groos's theory. My catalogue of plays is far from complete. It would be instructive to work from the other end, by making a complete catalogue of adult activities, and compare this with a

similar catalogue of infant play activities. It would be hard to get them all under Groos's blanket of anticipation, unless it be stretched rather beyond Groos's own usage. By making the law of selective utility of very broad generality, so as to include the general well-being induced by play as a factor of selective utility, one may make play fall under the domain of natural selection; but it is by no means evident that all the specific play activities of infancy are immediately and definitely propædeutic to specific necessary activities of maturity. It would be surprising, too, in this particular case if there were not found in the plays survivals of wild traits that are of no possible utility in their present mode of life. It is not improbable that some of the plays are mere kinetic equivalents for previous highly useful functions, the rudimentary organs of which persist in the infant organism. The subject of play is so new and so little exploited from the inductive side, that some important results ought to follow a careful study of the ontogenetic development of the play activities.

Affective States. From the very first, the young rats give evidence of experiencing feelings of general bodily discomfort, hunger, and pain. On the pleasurable side, they show signs of satisfaction when hunger and the desire for warmth are satisfied. Other emotional psychoses were manifested at later successive times.

Fear. The evidence of any fear psychosis, before the eyes and ears began to function, is not unequivocal. Before this, there were noted frantic efforts to recover disturbed equilibrium, violent reactions to sudden tactual stimulations and signs of disquietude when the rats came to the edge of the table, or when they were suspended from the finger. These reactions, however, are largely reflex, so it is impossible to say how much emotional significance they have. In view of the most satisfactory theories of emotion, the presumption is strong that there is an emotional accompaniment; at least, that there are organic disturbances, which are basic, physiologically, to emotional psychoses. On the other hand, it was quite clear that there was no instinctive fear of their natural enemies, mediated by the sense of smell, before the eyes and ears were open. The young rats showed not the slightest symptom of fear either of man or of cat, though I tested them almost daily by my own presence and by presenting my hand to their noses after having impregnated my hand with cat-odor by rubbing a cat. This fact is interesting in view of the opinion so generally held that animals with a keen sense of smell have a congenitally instinctive fear of their natural enemies. This is the more striking in the case of the rat, since his olfactory apparatus is extraordinarily well developed at birth. It must be assumed, how-

ever, that no instinctive fear exists. On the contrary, adult rats that have had no experience with cats show some uneasiness at the cat-odor. What the facts do seem to indicate is that the manifestation of instinctive fear waits upon the integration and functioning of the higher centers. An occurrence noted upon the same day the eyes and ears opened suggests to me that there may be an acceleration or consummation of this process simultaneously with the advent of these two senses. Before this time, handling of the rats had elicited no symptom of fear. On this occasion, however, one of the rats, when I put my hand into the nest and touched him from behind, ran hastily out of the nest. The significance of this action lies in its close simulation of the action of adult rats under like circumstances; they always show fear when touched suddenly from behind, but little or none if approached from before. If such an acceleration of development does take place at this time, it is not necessarily dependent upon the experience gained through these new sense avenues; the example cited could not be referred to any such experience, but must rather be referred to the functioning of the higher cerebral centers. It is patent, however, that after the functioning of the ears and eyes the fear field is immensely broadened, and becomes more specifically psychic.

Other specific emotions appear later. The pleasurableness of bodily comfort apparent in the first few days of life becomes positive joy when the neuro-muscular development permits of free and well co-ordinated movements—about the time of the opening of the eyes and ears. No case of anger was observed until very much later—not earlier than six or seven weeks. In all the tussling and fighting during play I have not seen a single rat lose his temper and "go at it in earnest."

Something like an altruistic sentiment is apparent in the mutual service which the young rats perform for each other by licking and "picking" vermin. I have recently seen adult rats tenderly lapping the eyes of sore-eyed mates. I think there is a considerable fund of altruism in the rat nature, in spite of the fact that they eat each other when very hungry—starving men do that!

Curiosity. As fear or timidity is the most striking of the emotional traits of the white rat, so is curiosity, of the *intellectual* traits. The premonitions of curiosity are to be seen in the restlessness of the young rats as soon as they are able to move freely. By the time they are three weeks old it is inordinate and overbalances fear. It is really curiosity, which is customarily spoken of as boldness by writers upon the natural history of the rat. Unless the rats happen to become special pets, their adult psychic life is a pretty even oscillation between these two states. Their curiosity is not entirely a matter of the stomach,

either. It may be supposed that a large part of their inquisitiveness is in the service of nutrition; but the biological necessity of safe surroundings is not less imperative. There is certainly a double root to this trait.

INTELLIGENCE. Upon this point there is little to be said. If we take intelligence in its objective, biological or teleological sense, *i. e.*, the power of the organism to adapt itself to new environment, the development of intelligence in these first four weeks is readily followed. At birth we see a larval organism, endowed with slight power of movement, insufficient to secure food and warmth, or to avoid danger, insensitive to all external excitations except temperature and odors, endowed with no psychic life beyond desire, and pleasure and pain. Gradually we see this organism change from its larval appearance to a form indicative of energy and activity. As the neuro-muscular system develops, all those instinctive activities so necessary to life appear one by one; and with the anatomical and functional development of the several sense-organs, advances, *pari passu*, the sensational horizon. The repertory of motor and emotional instincts, functional and psychic traits is rapidly filled out; and at the end of the fourth week of life, we have the young rat in full possession of that power to learn by experience, to seek out advantageous things, and to avoid dangerous things, which we call intelligence. Little would be gained here by attempting to resolve any specific process of intelligence into its elements. The one case of imitation noted is an example: the young rat saw the mother doing a certain thing and did it himself. The most obvious explanation of this process is that the visual image of what the young rat saw touched off a motor impulse resulting in similar action; but the explanation is superficial—it fails to touch the most important part of the question—how the visual image connects with the motor image, or impulse. Similarly, the complex mental process involved in the action of the rat that pushed his fellow away from a dish of milk in order to have free access himself, could receive only a superficial explanation in associational terms.

Finally, the chief value of a study of this kind is not in the analysis of the intellectual processes, valuable as that may be, but rather in getting a picture of the psychic make-up of the animal—an insight into his character through an appreciation of his fundamental psychic traits, which persist with undiminished vigor through the vicissitudes of an environment different in all its factors from that of the free wild life in which his psychic nexus was woven in the loom of necessity.

ROMANES' IDEA OF MENTAL DEVELOPMENT.[1]

By Marion Hamilton Carter, B. S.

In a previous paper the present writer discussed Darwin's Idea of Mental Development.[2] This second article follows closely the lines there laid down.

§ 1. General Psychology.

Before beginning an inquiry into the views of Romanes upon Mental Development and its place in evolutional theory, it will not be without profit to take a brief survey of the system of psychology which he held, and which was an integral portion of his philosophical creed.

Unlike Darwin, Romanes has been looked upon, more or less, as a psychologist, and has left us several volumes upon psychological and philosophical questions. His speculations were not confined to natural philosophy, but embraced the ultimate realities and the nature of things in their last analysis. Romanes had begun to be interested in metaphysical subjects in his early manhood, and throughout his life and almost to the day of his death devoted much of his most earnest and critical thought to the problems of Man, of Right, of Duty, and of the Ultimate First Cause. It is beyond the pale of this study to give an account of the changes which took place in his philosophical and religious views. It is sufficient here to say that his was a mind ever reaching out toward explanations more ultimate than those that could be given by a study of natural phenomena alone, and that to him the investigation of nature by purely inductive methods could never be adequate or satisfying. Throughout his work, therefore, we find constant attempts to systematize, to bring all the data of science into harmony with a general plan or cosmological scheme.

Romanes has left us three volumes dealing with human and animal psychology. In so extensive a contribution one may reasonably expect from an author a definite and systematic statement of the fundamental data of his subject. For this, however, the reader will search these books in vain. In the work entitled *Mental Evolution in Animals* Romanes has given

[1] From the Psychological Seminary of Cornell University.
[2] *Amer. Jour. of Psychology*, Vol. IX, No. 4.

us chapters on the Criterion of Mind, the Physical Basis of Mind, Consciousness, Sensations, Pleasures and Pains, Memory and Association of Ideas, Percepts, Imagination and Instinct. In the *Mental Evolution in Man* he has continued the former book by chapters on Ideas, Logic of Recepts, Logic of Concepts, Self-consciousness, and Language.

It is possible that a clear and concise statement of the bare facts of human psychology appeared to him unnecessary in his treatment of the subject. It was his purpose to trace the development of the various mental processes from those occurring in the lowest organisms to those in the highest; and owing to this purpose he probably thought it not incumbent upon him to attempt any special work in systematic psychology as such. In addition to this, he had had little or no training in psychology, and his knowledge of it was derived from reading. I believe it is due to both these facts that his work in psychology has so little coherence. He relied upon the work of others to a surprising degree, and his treatment of human psychology is almost entirely made up of quotations, and contains little or nothing original excepting his discussion upon 'Recepts.' Romanes was the inventor of the term 'recept.' "In addition, then, to the terms Percept and Concept, I coin the word *Recept*. This is a term which seems exactly to meet the requirements of the case. For as perception literally means a *taking wholly*, and conception a *taking together*, reception means a *taking again*. Consequently, a recept is that which is taken again, or a re-cognition of things previously cognized. Now, it belongs to the essence of what I have defined as compound ideas (recepts), that they arise in the mind out of a repetition of more or less similar percepts."[1] 'Recepts' are general ideas which have not been given a name, and have not been consciously classified. The associations we have with them are of the passive kind, as the associations we have with the cognate words are of the active kind. In receiving such ideas the mind is passive, as in conceiving abstract ideas the mind is active. "Recepts, then, are *spontaneous associations*, *formed unintentionally* as what may be termed *unperceived abstractions*."[2]

In the *Mental Evolution in Man* Romanes devotes a lengthy chapter to the logic of recepts—a chapter much padded with quotations from Sully, Perez, J. S. Mill, Mansel, Huxley, Lazarus, Steinthal, F. Müller, Comte, Binet, G. H. Lewes, Darwin, Preyer, Leroy, Locke, Taine, besides some of his own previous works. What he wishes to set forth here is that along with "the logic of signs, there is a logic of images, and a logic

[1] *Mental Evolution in Man*, p. 36.
[2] *Ibid.*, p. 37.

of feelings."[1] The word 'recept' is taken to cover all those cases of the ideas on the borderland between percepts and concepts,—a disputed and often unrecognized region which Romanes set himself to investigate. "The question, then, which we have to consider is whether there is a difference of kind, or only a difference of degree, between a recept and a concept. This is really the question with which the whole of the present volume will be concerned."[2]

Romanes distinguished five kinds of ideas: the percept (a simple memory image), lower recepts, higher recepts, lower concepts, higher concepts, forming a perfect developing series, the one being closely united with the other by derivation, *i. e.*, by growth from the lower to the higher. In order to elaborate this theory more fully he had recourse to philology, and traced back the conceptual meanings of words to their 'receptual' origin. The following paragraph sums up his results clearly:

"Now I hold that this receptual nucleus of all our conceptual terms furnishes the strongest possible evidence, not only of the historical priority of the former, but also of what Professor Max Müller calls their 'dire necessity' to the growth of the latter. In other words, the facts appear conclusively to show that conceptual connotation (denomination) has always had—and can only have had—a receptual core (denotation) around which to develop. Psychological analysis has already shown us the psychological priority of the recept; and now philological research most strikingly corroborates this analysis by actually finding the recept in the body of every concept."

Thus Mental Evolution for him consisted not in Feeling, not in Sensitivity to Pleasure or Pain, not in Co-ordinated Movements, not in Will, but in the various types of Ideation from percept to 'higher concept,' in a progressive series,—from the mere recognition of sense impressions *as such*, to a classification of them, and a classification *known as such*. Between the percept and the concept the unnamed general idea formed for him the natural link, and in the field of unnamed general ideas Romanes thought he had discovered a *terra incognita* to be explored and exploited for the benefit of evolutional psychology. The data which he collected regarding human and animal psychology were examined and evaluated largely with reference to the light they threw upon his theory of recepts; and he made excursions into every region which seemed to promise facts bearing in any way upon it.

It will thus be seen that the term 'recept,' in giving him a clearly named, unbroken line of ideation from lower to higher, against which he could measure the ideation of any given individual or species of animals, was the keystone to the arch sup-

[1] *Ibid.*, p. 42.
[2] *Ibid.*, p. 45.

porting the larger part of his theory of mental development. The 'recept' was, in fact, the *sine qua non* of his evolutional psychology; he invented the term, defined its limits, and published a volume (*Mental Evolution in Man*), the bulk of which was devoted to the proof of the existence of recepts and the exposition of his theories concerning them. It was, therefore, a matter of considerable regret to him that the word was not recognized by psychologists and obtained no hold in scientific nomenclature.

The reason for this is obvious from the quotations given. A 'recept' signifies no new conscious element or connection of elements, no process which differs in kind from those already well known to psychology. The term stands for a logical, not a psychological fact, and it has, therefore, no place in the psychological analysis of mental processes. The moment this is appreciated the keystone drops from the arch, carrying with it most of the superstructure, and leaving in ruins the greater part of Romanes' work upon mental development. In his evolutional scheme he obtained intelligence from the upward push of reflex action through instinct, and his theory of the subsequent development of mind itself he builds from materials which for psychology, at least, do not exist. However mind may evolve, it certainly does not evolve by means of the number or complexity of the terms which can be logically analyzed as coming under the head of a single psychological process. Mental development, if it be a reality, is something other than a procession of logical categories.

Romanes' most popular work was his 'Animal Intelligence.' The collection of the material for this occupied him many years, was derived from a great variety of sources, and was critically sifted, all instances not well attested being excluded. To the facts given, however, he added his own interpretations,—interpretations frequently so anthropomorphic and crude as to have scarcely a shadow of a claim to the consideration of the student of psychology. Some of these are not of his actual authorship, but since he quotes them without comment we are justified in laying the responsibility for them upon him.

From the Rev. W. Farren White he gives the following: "I have noticed in one of my formicaria a subterranean cemetery, where I have seen some ants burying their dead by placing earth above them. *One ant was evidently much affected*, and tried to exhume the bodies, but the united exertions of the yellow sextons were more than sufficient to neutralize the effort of the *disconsolate mourner*."[1] [Italics mine.]

He quotes from Dr. Kemp an account of a strange queen bee attempting to enter a hive; the workers "surround her and hold her until she

[1] *Animal Intelligence*, p. 92.

starves to death; *but such is their respect for royalty* that they never attempt to sting her."[1] [Italics mine.]

It is needless to multiply instances,[2] as I must give in full the tale of the Cat and the Thumb-latch.

"My own coachman once had a cat which, certainly without tuition, learnt thus to open a door which led into the stables from a yard into which looked some of the windows of the house. Standing at these windows when the cat did not see me, I have many times witnessed her *modus operandi*. Walking up to the door with a most matter-of-course kind of air, she used to spring at the bottom of this half-loop handle just below the thumb-latch. Holding on to the bottom of this half-loop with one fore-paw, she then raised the other to the thumb-piece, and while depressing the latter, finally with her hind legs scratched and pushed the doorposts so as to open the door. Precisely similar movements are described by my correspondents as having been witnessed by them.

"Of course, in all such cases the cats must have previously observed that the doors are opened by persons placing their hands upon the handles, and, having observed this, the animals forthwith act by what may be strictly termed rational imitation. But it should be observed that the process, as a whole, is something more than imitative. For not only would observation alone be scarcely enough (within any limits of thoughtful reflection that it would be reasonable to ascribe to an animal) to enable a cat upon the ground to distinguish that the essential part of the process as performed by the human hand consists, not in grasping the handle, but in depressing the latch; but the cat certainly never saw any one, after having depressed the latch, pushing the doorposts with his legs; and that this pushing action is due to an originally deliberate intention of opening the door, and not to having accidentally found this action to assist the process, is shown by one of the cases communicated to me (by Mr. Henry A. Gaphaus); for in this case, my correspondent says, 'the door was not a loose-fitting one by any means, and I was surprised that by the force of one hind leg she should have been able to push it open after unlatching it.' Hence we can only conclude that the cats in such cases have a very definite idea as to the mechanical properties of a door; they know that to make it open, even when unlatched, it requires to be *pushed*—a very different thing from trying to imitate any particular action which they may see to be performed for the same purpose by man. The whole psychological process, therefore, implied by the fact of a cat opening a door in this way is really most complex. First the animal must have observed that the door is opened by the hand grasping the handle and moving the latch. Next she must reason by 'the logic of feelings'—if a hand can do it, why not a paw? Then, strongly moved by this idea, she makes the first trial. The steps which follow have not been observed, so we cannot certainly say whether she learns by a succession of trials that depression of the thumb-piece constitutes the essential part of the process, or, perhaps more probably, that her initial observations supplied her with the idea of clicking the thumb-

[1] *Ibid.*, p. 164.

[2] Parallel cases will be found on the following pages of *Animal Intelligence:* pp. 76, 88, 90, 92, 94, 157, 158, 160, 162, 166, 169, 183, 187, 196, 211, 227, 228.

In *Mental Evolution in Animals*, p. 156, the story of the Dog and the Bone rivals, in interpretation, that of the Cat and the Thumb-latch.

piece. But, however this may be, it is certain that the pushing with the hind feet after depressing the latch must be due to adaptive reasoning unassisted by observation; and only by the concerted action of all her limbs in the performance of a highly complex and most unnatural movement is her final purpose attained."[1]

The cat's reasoning processes by 'the logic of feelings' call for no comment from me, but of the last sentence I may say that it seems typical of all of Romanes' psychological work. "It is certain," he says, "that the pushing with the hind feet after depressing the latch must be due to *adapted reasoning unassisted by observation*." [Italics mine.] Cat pushes door with hind feet; cat makes necesary adjustments by 'adaptive reasoning.' Now the pushing may have been 'unassisted by observation,' but it does not follow that it was a result of 'adaptive reasoning,'—whatever that may mean. This is a fair sample of the kind of explanation that scientific men with little knowledge of psychology turn out as contributions to psychology.

Now to provide the very first step of proof for 'adaptive reasoning' in the cat-case we ought to have had the cat's *first spring* at the door-latch described to the minutest details. Could we see the cat on the ground laying her plans, and then forthwith carrying them out promptly and perfectly, we might be able to attribute the results to 'adaptive reasoning;' but since a minute account of the first spring is not forthcoming, the only probable explanation is that when the cat hung upon the thumb-latch she tried, after the manner of cats, to obtain additional support for her weight by driving the claws of her hind feet into the wood work. Being near the jamb, one of her feet rested easily upon it; an accidental and harder push with that foot caused the door to give slightly. The opening of the door being her object, her attention is sooner or later caught by the connection between her own push and the movement of the door. The action once accomplished is again and again repeated until perfected.

I have seen an analogous case with a kitten. She has tried to leap upon a window sill from the floor. Three long curtains hang from the top of the window, a lace net, which covers the window, and two velvet curtains which hang one at each side. After a great many ineffectual attempts to penetrate the lace at the middle of the window, the kitten on one occasion endeavored to climb up the curtains where the velvet overlapped the lace. In pulling first on one and then on the other, while mounting step by step, she separated the curtains, and thus easily reached the sill. This happy accident, repeated many times, has led to her complete mastery of the adjustments of

[1] *Animal Intelligence*, pp. 420-22.

actions necessary to reach the sill. Having watched her first attempts and her numberless failures, it seems to me it would take a large fund of credulity, imagination and ignorance combined to assign to the finished product even a modicum of 'adaptive reasoning.'

The cat and the thumb-latch story shows a complete absence of experience in tracing the genesis of a process, and is sufficient to discredit a man's whole work in comparative psychology. Common observation of the early actions of an animal ought to be enough to prevent the wholesale importation of reasoning processes into the explanation of the later and perfected actions, just because those actions appear as reasonable. In everyday language, all action performed with an end in view is considered reasonable, provided that the end makes for the advantage of the individual, but it does not, therefore, follow that any reasoning process whatever is called into play.

Before closing this survey of the contributions Romanes made to general psychology I must say a few words regarding his writings as a whole. Unfortunately much of the usefulness of his work is impaired by his literary style. In his large books on Mental Evolution there are literally dozens of pages, supposed to stand for general surveys or general summaries, which are merely collections of remarks to the reader about what he has seen, will see, or ought to see, if he looks,—remarks which add nothing to the author's statements or arguments. Besides these, there are hundreds of lines telling us what the author is about to do next.[1] In the chapter on Comparative Philology alone these remarks amount to nearly a printed page.

Good as some of his work really was, the verbosity of his style, the constant and lengthy quotations, the repetition of earlier and the anticipation of later statements and arguments, make his books difficult and unprofitable reading for the student of biology, psychology or philosophy.

That he carried weight in his day and generation is a fact. Why he carried the weight he did is to be explained more by the outward conditions of his life than by the value of his work from either a literary or a scientific point of view. He was the friend of Darwin,—to a certain extent, his literary executor, in that he received all of Darwin's notes on psychology, and published the essay on Instinct as an Appendix to a book of his own; his work in physiology had received favorable notice from most of the leading physiologists of his day; being the man that he was as a personality, as a friend,—and, above all, writing at a time when any one giving a fairly lucid exposition of the principles of evolution received attention, and was

[1] See, for instance, *Mental Evolution in Man*, pp. 244-45.

regarded as an authority,—with all these facts conspiring in his favor, it is hardly to be wondered at that Romanes obtained for himself a hearing and carried weight with the general public out of all proportion to the value of his work.

One cannot read his psychological books and deny that he was painstaking in the collection of material and careful in its elaboration; or, on the other hand, deny that his ill-worked-out theories are based upon voluminous quotations from writers, some of whom were even then antiquated, and many more, specialists in subjects other than those in whose support they are cited. One lays them down with the feeling that they form but an amorphous, inorganic whole.

§ 2. Mind in the Causal Series.

Does mind come into the causal series of organic evolution at large? Is it actively concerned in progress, *i. e.*, has it a "survival value?"

Regarding mind in the causal series at large, Romanes is either much less certain, or much more guarded in his views than Darwin, and he has left us both meager and somewhat contradictory statements concerning it. He says: "We have now seen that instincts may have what I term a blended origin —or, in other words, that intelligent adjustment by going hand in hand with natural selection, must greatly assist the latter principle in the work of forming instincts, inasmuch as it supplies to natural selection variations which are not merely fortuitous, but from the first adaptive. I shall next show what I conceive to be the chief modes in which intelligence thus operates, or co-operates with selection, in the formation of instincts."[1] This would seem to indicate that mind was 'actively concerned in progress.' And in his Rede lecture 'Mind and Motion'[2] he has the following:

"To adduce only one other consideration. Apart from all that I have said, is it not in itself a strikingly suggestive fact that consciousness only, yet always, appears upon the scene when the adjustive actions of any animal body rise above the certain level of intricacy to which I have alluded? Surely this large and general fact points with irresistible force to the conclusion, that in the performance of these more complex adjustments, consciousness—or the power of feeling and the power of willing—is of some *use*. Assuredly on the principles of evolution, which materialists at all events cannot afford to disregard, it would be a wholly anomalous fact that so wide and important a class of faculties as those of the mind should have become developed in constantly ascending degrees throughout the animal kingdom, if they were entirely without use to animals. And, be it observed, this consideration holds good whatever views we may happen to enter-

[1] *Mental Evolution in Animals*, p. 219.
[2] *Mind and Motion*, pp. 24-5.

tain upon the special theory of natural selection. For the consideration stands upon the general fact that all the organs and functions of animals are of use to animals: we never meet, on any large or general scale, with organs and functions which are wholly adventitious. Is it to be supposed that this general principle fails just where its presence is most required, and that the highest functions of the highest organs of the highest animals stand out of analogy with all other functions in being themselves functionless? To this question, I, for one, can only answer, and answer unequivocally, no. As a rational being who waits to take a wider view of the facts than that which is open to the one line of research pursued by the physiologist, I am forced to conclude that not without a reason does the mind exist in the frame of things: and that apart from the activity of mind, whereby motion is related to that which is not motion, this planet could never have held the wonderful being, who in multiplying has replenished the earth and subdued it—holding dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth."

He speaks of the art of writing as of "inestimable advantage" to civilized man over savage man in "the consequent transmission of effects of culture from generation to generation."

"Quite apart from any question as to the hereditary transmission of acquired characters, we have in this *intellectual* transmission of acquired *experience* a means of accumulative cultivation quite beyond our powers to estimate. For, unlike all other cases where we recognize the great influence of individual use or practice in augmenting congenital 'faculties' (such as in the athlete, pianist, etc.), in this case the effects of special cultivation do not end with the individual life, but are carried on and on through successive generations *ad infinitum*. Hence, a civilized man inherits mentally, if not physically, the effects of culture for ages past, and this in whatever direction he may choose to profit therefrom. Moreover—and I deem this an immensely important addition—in this unique department of purely intellectual transmission, a kind of non-physical natural selection is perpetually engaged in producing the best results. For here a struggle for existence is constantly taking place among 'ideas,' 'methods,' and so forth, in what may be termed a psychological environment. The less fit are superseded by the more fit, and this not only in the mind of the individual, but, through language and literature, still more in the mind of the race."[1]

It would seem from this that he looked upon intelligence as having a "survival value" in the organic series.

In his philosophical views as to the ultimate relations of brain and mind, of which I shall speak later, Romanes was a monist, and this position would be irreconcilable with any concept of mind as *dipping into* a progressing series at various points, and acting thereby as a causal agent.

The quotations given, indicative of a causal relation between mind and an organic series, contain nearly all that Romanes said upon the subject. In view of the meagerness of his remarks, and of what must be termed their distinctly contra-

[1] *Darwin and After Darwin*, p. 33.

dictory character when taken in the light of his monistic theory of the relation of mind and body, we can only safely say that mind played *some* part in Romanes' scheme of organic evolution, but just what he does not tell us.

§ 3. Definition of Mind.

Unlike Darwin, Romanes was precise in his definition of mind. In the Introduction to *Animal Intelligence* he gives us an explicit statement of what he intended the term to cover, a statement which he substantially repeated in *Mental Evolution in Animals*. Romanes drew the line of mind much more closely than did Darwin. His purpose, however, differed widely from Darwin's, and it was to the advantage of his theory of mental evolution to limit, rather than to extend the meaning of his term. The purpose which underlay his entire work in evolutional psychology was the proof of the "probable genesis of mind from non-mental antecedents."[1] By placing the most rigorous strictures upon mental elements, the non-mental elements were brought within easy reach of the theory, being nothing more nor less than instinctive and reflex actions,—two sorts of action which Darwin had included in a general lump sum of mentality.

The criteria of mind for Romanes were threefold: first, the manifestation must be present in a living organism; 2nd, the manifestation must exhibit consciousness and choice; and, lastly, the organism must show itself "able to learn by its own individual experience." Mental evolution he expressed in a comparatively simple series: Reflex Action, Instinct, Intelligence.

"*Reflex* action is non-mental neuro-muscular adjustment, due to the inherited mechanism of the nervous system, which is formed to respond to particular and often recurring stimuli by giving rise to particular movements of an adaptive, though not of an intentional kind.

"*Instinct* is reflex action into which there is imported the element of consciousness. The term is, therefore, a generic one, comprising all those faculties of mind which are concerned in conscious and adaptive action, antecedent to individual experience, without necessary knowledge of the relation between means employed and ends attained, but similarly performed under similar and frequently recurring circumstances by all the individuals of the same species.

"*Reason* or intelligence is the faculty which is concerned in the intentional adaptation of means to ends. It therefore implies the conscious knowledge of the relation between means employed and ends attained, and may be exercised in adaptation to circumstances

[1] *Animal Intelligence*, p. 3. On p. 5 'evolution' is substituted for 'genesis.'

novel alike to the experience of the individual and to that of the species."[1]

To the above quotation may be added these further statements taken from the *Mental Evolution in Animals.*

"Whenever this stage is reached, and a nerve center begins to become conscious of its own working, we pass, according to my classification, from the domain of reflex action into that of instinct—instinct being in my terminology reflex action into which there is imported the element of consciousness."[2]

"Now, in so far as instinct requires to be mixed with intelligence in order to be effective, it is as an instinct imperfect; it is as an instinct in course of formation, or at any rate not perfectly adapted to the possible circumstances of life."[3]

"While the stimulus to a reflex action is, at most, a sensation, the stimulus to an instinctive action can only be a perception."[4]

"The advent and development of consciousness, although progressively converting reflex action into instinctive, and instinctive into rational, does this exclusively in the sphere of subjectivity;"[5] and "instinct passes into reason by imperceptible degrees."[6]

In view of the facts, however, Romanes was not able to maintain the continually upward trend of instinct, but was obliged to admit that instincts were mixed in their origin, some being "pure," and some "lapsed intelligence;" the latter he called secondary instincts.

" . . . . Adjustments originally intelligent may, by frequent repetition, become automatic, both in the individual and in the race; as instances of such 'lapsed intelligence' in the individual I have given the highly co-ordinated and laboriously acquired actions of walking, speaking, and others."[7]

Almost the whole of Vol. II of *Darwin and After Darwin* is devoted to the question of character as hereditary and acquired, and hence to those of the development and meaning of reflex action, instinct and intelligence, and of the inheritance of structural useful or non-useful peculiarities. His earlier views are here treated somewhat more from a biological standpoint; nevertheless there is substantial agreement with those of his psychological work.

To sum up, then, Romanes meant by the term 'mind' Intelligence in the common acceptation of the word, and did not include in it either instinct or reflex actions.

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[1] *Ibid.*, p. 7.
[2] *Mental Evolution in Animals*, p. 319.
[3] *Ibid.*, p. 176.
[4] *Ibid.*, p. 260.
[5] *Animal Intelligence*, p. 12.
[6] *Ibid.*, p. 16.
[7] *Mental Evolution in Animals*, p. 200.

§ 4. Relation of Mind and Body.

If Romanes was not clear upon the place of mind in an evolving series, he had, on the other hand, worked out clearly and somewhat fully the relation obtaining between mind and body. For him, as for Darwin, there was a distinct parallelism between "structural affinity and mental development."

"There is, indeed, a general and, philosophically considered, most important parallelism running through the whole animal kingdom between structural affinity and mental development; but this parallelism is exceedingly rough, and to be traced only in broad outlines, so that although it is convenient for the purpose of definite arrangement to take the animal kingdom in the order presented by zoölogical classification, it would be absurd to restrict an inquiry into Animal Psychology by any considerations of the apparently disproportionate length and minute subdivision with which it is necessary to treat some of the groups. Anatomically, an ant or a bee does not require more consideration than a beetle or a fly; but psychologically there is need for as great a difference of treatment as there is in the not very dissimilar case of a monkey and a man."[1]

This rough parallelism, however, betokened a deeper, underlying unity in the relation of mind and body,—a relation, not between mind and body in gross, but between consciousness and nerve processes. "We have already taken it for granted that Mind has a physical basis in the functions of the nervous system, or that every mental process has a corresponding equivalent in some neural process. I shall next endeavor to show how precise this equivalency is."[2]

And again. "It is enough if we are agreed that every psychical change of which we have any experience is invariably associated with a definite physical change, whatever we may suppose to be the nature and significance of this association."[3]

He also pointed out the parallelism between pathological mental and physical states. "But for the sake of systematic completeness I shall conclude this exposition by briefly pointing out that all those pathological derangements which occur in the nervous centers that preside over muscular activities, have their parallels in similar derangements which occur in the nervous centers that are concerned in mental activities."[4]

In the *Mental Evolution in Animals* Romanes devotes several chapters to the nervous system as the physical basis of mind; not only is brain the seat of mind, but its microscopic elements are the substrate of mental processes, and in these elements he finds the objective side of psychical processes from simple sensation to complex association.

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[1] *Animal Intelligence*, pp. 9 and 10.
[2] *Mental Evolution in Animals*, p. 34.
[3] *Ibid.*, p. 47.
[4] *Ibid.*, p. 44.

The following quotations will make this clear:

"This, of course, is just as it ought to be, if the brain, which the skull has to accommodate, has been gradually evolved into larger and larger proportions in respect of its cerebral hemispheres, or the upper masses of it *which constitute the seat of intelligence.*"[1] [Italics mine.]

"Within experience mind is invariably associated with highly differentiated collocations of matter and distributions of force, and many facts go to prove, and none to negative, the conclusion that the grade of intelligence invariably depends upon, or at least is associated with, a corresponding grade of cerebral development."[2]

"That the grey matter of the cerebral hemispheres is the exclusive seat of mind is proved in two ways. In the first place, if we look to the animal kingdom as a whole, we find that, speaking generally, the intelligence of species varies with the mass of this grey matter. Or, in other words, we find that the process of mental evolution, on its physical side, has consisted in the progressive development of this grey matter superimposed upon the pre-existing nervous machinery, until it has attained its latest and maximum growth in man.

"In the second place, we find that when the grey matter is experimentally removed from the brain of animals, the animals continue to live; but are completely deprived of intelligence. All the lower nerve centers continue to perform their mechanical adjustments in response to suitable stimulation; but they are no longer under the government of the mind."[3]

"There can be no doubt that in the complex structure of the cerebral hemispheres one nervous arc (*i. e.*, fibres, cells and fibres) is connected with another nervous arc, and this with another almost *ad infinitum;* and there can be equally little doubt that processes of thought are accompanied by nervous discharges taking place, now in this arc, and now in that one, according as the group of nerve-cells in each arc is excited to discharge its influence by receiving a discharge from some of the other nerve-arcs with which it is united. . . . . We thus see that the most fundamental of psychological principles—the association of ideas—is merely an obverse expression of the most fundamental of neurological principles—reflex action."[4]

The problem which confronted him consisted in showing that if body could be looked upon in any way as the physical substrate of mind, a relation must exist between them such that phenomena occurring in the one must subtend corresponding phenomena occurring in the other. Without such correspondence of phenomena in the two, a relation between them, if present, would be beyond the bounds of human demonstration. Unable to find an exact parallelism between gross anatomy and mind, Romanes endeavored, by reducing his terms to microscopic proportions, likewise to reduce the difficulties of his problem.

But not even in the cell did he discover a final and satisfactory solution, and he was obliged to appeal to plain matter and force in the last analysis.

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[1] *Darwin and After Darwin*, Vol. I, p. 196.
[2] *Theism*, p. 103.
[3] *Mind and Motion*, pp. 5-6.
[4] *Mental Evolution in Animals*, pp. 37-8.

"What we know as mind is dependent (whether by way of causality or not is immaterial) on highly complex forms of *what we know* as Matter, in association with peculiar distributions of *what we know* as Force."[1]

In a work entitled *Mind and Motion and Monism*, most of the chapters of which have appeared as magazine articles, he takes up the metaphysical side of this relation of mind and body. After discussing causality in general, he points out that "the only resemblance between this supposed case of causation (from neurosis to psychosis) consists in the invariability of the correlation between cerebral process and mental processes; in all other points the analogy fails."[2]

"I could certainly prove that whatever the connexion between body and mind may be, we have the best possible reasons for concluding that it is not a causal connexion."[3]

The following paragraph from *Theism*, written some twenty years earlier, takes up the same position as is held in the *Mind and Motion and Monism:*

"So long as Matter and Mind, x and y, are held to be antithetically opposed in substance, so long must materialism suppose that a connection of causality subsists between the two, such that the former substance is *produced* in some unaccountable way by the latter. But when Mind and Matter, x and y, are supposed to be identical in substance, the need for any additional supposition as to a causal connection is excluded. But unless we hold what seems to me an uncalled for opinion, that the essential feature of Materialism consists in a postulation of a causal connection between x and y, it would appear that the only effect of supposing x and y to be really but one substance, z, must be that of *strengthening* the essential doctrine of Materialism—the doctrine, namely, that conscious intellectual existence is *necessarily* associated with that form of existence which we know phenomenally as Matter and Motion. If it is true that a "moving molecule of inorganic matter does not possess mind or consciousness, but it possesses a small piece of Mind-stuff," then assuredly the central position of Materialism is shown to be impregnable. For while it remains as true as ever that mind and consciousness can only emerge when what we know phenomenally as "Matter takes the complex form of living brain," we have abolished the necessity for assuming even a causal connection between the substance of what we know phenomenally as matter and the substance of what we know phenomenally as Mind: we have found that, in the last resort, the phenomenal connection between what we know as Matter and what we know as Mind is actually even more intimate than a connection of causality; we have found that it is a substantial identity."[4]

Since it is not within the scope of this study to give the arguments by which our author reached his conclusions, but merely to state the views he held upon certain definite questions, I will

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[1] *Theism*, p. 188.
[2] *Mind and Motion and Monism*, p. 62.
[3] *Ibid.*, p. 20.
[4] *Theism*, pp. 186-7.

sum up his various writings upon the ultimate nature of the relation of mind and body by saying that Romanes held it to be much deeper than a causal connection. The known data were to him inexplicable upon the theory of the interaction of two independent realities, and it was in the theory of monism that he sought, and believed that he had found, the solution of his problem. "This theory is, as we have already seen, that *mental phenomena* and *physical phenomena*, although apparently *diverse, are really identical.*"

"If we thus unite in a higher synthesis the elements both of spiritualism and of materialism, we obtain a product which satisfies every fact of feeling on the one hand, and of observation on the other. We have only to suppose that the antithesis between mind and motion—subject and object—is itself phenomenal or apparent; not absolute or real. We have only to suppose that the seeming duality is relative to our modes of apprehension; and, therefore, that any change taking place in the mind, and any corresponding change taking place in the brain, are really not two changes, but one change."[1]

§ 5. What Evolves in Mental Evolution?

What evolves in 'mental evolution,'—mind, body, or both mind and body? If mind only, how can it influence organic evolution? If body only, how does its evolution carry with it the evolution of mind? If both, what is the course of 'mental evolution?'

From the data already given regarding the relation of mind and body, the question as to what evolves in mental evolution might almost be expected to answer itself. Not so. No problem which Romanes wrote upon was so clumsily treated, or left more at loose ends than this. With the statement of the absolute monism of mind and body, the presence of mind in each and every bodily, or at least neural process would seem a necessary deduction. For him it was otherwise.

Romanes had taken upon himself the task of elucidating a theory of mental development in which the genesis of mind is to be traced from non-mental elements, *i. e.*, from instinct and reflex action and, indeed, from physiology itself. This evolutional theory attempted to do for mind what Darwin had done for species, to show a graded series from lower to higher, and a continuity in that series by means of natural inheritance.

"My position is that Mind is everywhere continuous, and if for purposes of analysis or classification we require to draw lines of demarcation between the lower and the higher faculties thereof, I contend that we should only do so as an evolutionist classifies his animal or vegetable species: higher or lower do not betoken differences of *origin*, but differences of *development*."[2]

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[1] *Mind and Motion and Monism*, pp. 83-84.
[2] *Mental Evolution in Man*, p. 234.

"I hold that if the doctrine of Organic Evolution is accepted, it carries with it, as a necessary corollary, the doctrine of Mental Evolution, at all events as far as the brute creation is concerned. For throughout the brute creation, from wholly unintelligent animals to the most highly intelligent, we can trace one continuous gradation; so that if we already believe that all specific forms of animal life have had a derivative origin, we cannot refuse to believe that all the mental faculties which these various forms present must likewise have had a derivative origin. And, as a matter of fact, we do not find any one so unreasonable as to maintain, or even to suggest, that if the evidence of Organic Evolution is accepted, the evidence of Mental Evolution, within the limits which I have named, can consistently be rejected. The one body of evidence therefore serves as a pedestal to the other, such that in the absence of the former the latter would have no *locus standi* (for no one could well dream of Mental Evolution were it not for the evidence of Organic Evolution, or for the transmutation of species); while the presence of the former irresistibly suggests the necessity of the latter, as the logical structure for the support of which the pedestal is what it is."[1]

Such are the general outlines of his fundamental postulates of the evolution of mind.

The *modus operandi* is less simple than it seems. Having started to evolve mind from non-mental elements, Romanes has recourse to physiology, and there finds the root principles of intelligence.

"Looking, then, at the phenomena of Mind as invariably presenting a physical, or, as we may indifferently call it, a physiological side, I shall endeavor to point out what I conceive to be the most ultimate principle of physiology which analysis shows to be common to them all. On the mental side, as we have already seen, we have no difficulty in distinguishing this ultimate principle, or common characteristic, as that which we designate by the term Choice. Now if the power of choice is the distinctive peculiarity of a mental being, and if, as we have taken for granted, every change of Mind is associated with some change of Body, it follows that this distinctive peculiarity ought to admit of being translated into some physiological equivalent. Further, if there is any such physiological equivalent to be found, we should expect to find it much lower down in the scale of physiological development than in the functions of the human brain. For not only do the lower animals manifest, in a long descending scale, powers of choice which gradually fade away into greater and greater simplicity; but we should be led *a priori* to expect, if there is a physiological principle which constitutes the objective basis of the psychological principle, that the former should manifest itself more early in the course of evolution than the latter. For, whatever views we may entertain concerning the relation of Body and Mind, there can be no question, on the basis of the evolution theory which I assume, that, as a matter of historical sequence, the principles of physiology were prior to those of psychology; and therefore, if in accordance with our original agreement we allow that the latter have a physical basis in the former, it follows that the principles of physiology, which now constitute the objective basis of choice, whatever they may be, probably came into operation long before they were sufficiently evolved thus to constitute the foundation of psychology."[2]

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[1] *Mental Evolution in Animals*, p. 8. [2] *Ibid.*, pp. 47-8.

It is to excitability that he looks for a solution of the problem. "Thus, co-extensive with the phenomena of excitability, that is to say, with the phenomena of life, we find this function of selective discrimination; and, as I have said, it is this function that I regard as the root-principle of Mind. . . . . The distinguishing property of mind, on its physiological side, consists in this power of discriminating between different kinds of stimuli, irrespective of their degrees of mechanical intensity."[1]

To the question, then, 'what evolves in mental evolution, mind or body?' Romanes answers "Both evolve;" yet by the above showing there is not a mutual conditioning of each by the other—as Darwin held regarding them—but a very definite and precise conditioning of the mind by the body, never the reverse.

From mere excitability and discrimination of single cells, we pass upward to "ganglia which have fully *learned* their work" (*M. E. in A.*, p. 36), or "a ganglion (which) may *forget* its activity" (*Ibid.*, p. 75), until at last we find that "Reasoning consists in a selective discrimination among all those exceedingly delicate stimuli which, on their subjective side, we know as arguments. Similarly regarded, Judgment is likewise nothing more than the final result of the incidence of a vast number of very delicate stimuli; and this final result, like all the intermediate steps of the reasoning which led to it, is nothing more than the exercise of a power to discriminate between the stimulus which on its subjective side we recognize as the right, and that which we similarly recognize as the wrong. Lastly, Volition, subjectively considered, is the faculty of consciously selecting motives; and motives, objectively considered, are nothing more than immensely complex and inconceivably refined stimuli to nervous action."[2]

In the course of Mental Evolution, then, physiological function and morphological structure precede the advent of mental activity in point of time, *and the evolution of these carries with them the evolution of Intelligence* by means of the increasing differentiation and complexity of the neural elements which serve as the Physical Basis of Mind.

Summary.

We have seen (1) that Romanes held but vaguely that mind is causally related to organic evolution; (2) that the relation of mind to body was one of complete monism; (3) that by *mind* he meant only such manifestations of the living organism as

[1] *Ibid.*, pp. 51 and 53.
[2] *Mental Evolution in Animals*, p. 53.

gave evidence of purpose and choice; and (4) that Mental Development "consists essentially in a progressive co-ordination of progressively developing faculties" (*M. E. in A.*, p. 40), preceded by a morphological and physiological evolution of its physical substrate, the body.

His postulation of the development of Mind from non-mental elements, together with the priority of physiology over mind in point of time, give him a philosophical position among the Materialistic Monists.[1]

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[1] It may throw a side light upon Romanes' views to glance at the literature to which he referred in his psychological works. Some fifty titles will be found in the books on Mental Evolution, the most important authors being Bain, Bastian, Binet, Carpenter, Darwin, Fiske, Houzeau, Huxley, Lazarus, Lewes, Maudsley, Jas. Mill, J. S. Mill, Max Müller, Perez, Preyer, Ribot, Spencer, Sully, Taine and Wundt. If we may judge from the quantity and general character of his quotations, Romanes seems to have derived his psychology mainly from the following five volumes: G. H. Lewes, *Problems of Life and Mind;* Max Müller, *Science of Thought;* Herbert Spencer, *Principles of Psychology;* H. Taine, *On Intelligence;* W. Wundt, *Vorlesungen über die Menschen u. Thierseele.*

It is hard to understand how a careful student could print work upon psychology, and yet omit to mention a score, at least, of the most important books on the subject. The year of the publication of *Mental Evolution in Man* (1889), Fechner's *Elemente der Psychophysik* had reached even its second edition. It is equally hard to see how one can write upon philosophy—upon monism and fundamental principles—and depend upon W. K. Clifford and Herbert Spencer as the chief authorities, never mentioning Kant, Fichte, Schelling, Hegel, Lotze, Wundt, or Avenarius.

MINOR STUDIES FROM THE PSYCHOLOGICAL LABORATORY OF CORNELL UNIVERSITY.

COMMUNICATED BY E. B. TITCHENER.

XVIII. FLUCTUATION OF THE ATTENTION TO MUSICAL TONES.

BY H. O. COOK, B. S.

In the *Anzeiger der Akademie der Wissenschaften in Krakau*, November, 1898, appeared an abstract of a paper by Dr. W. Heinrich, entitled *Zur Erklärung der Intensitätsschwankungen eben merklicher optischer und akustischer Eindrücke.* In the course of this abstract, Dr. Heinrich mentions, as a "ganz unerwartetes Resultat" of his experimental investigation, that minimal tones do not fluctuate ("dass bei Tönen keine Intensitätsschwankungen zu beobachten waren:" p. 374). Trial was made of the high tones of a Galton whistle, and of tones from the middle and lower regions of the scale given by organ-pipes and wide glass tubes. Dr. Heinrich himself was the sole observer (p. 373).

It is with this "wholly unexpected result," and not with any other of Dr. Heinrich's facts or hypotheses, that we are concerned in the present Study. The result seemed to need confirmation, for two reasons. In the first place, experiments upon the fluctuation of attention are regularly carried out in the drill-course in laboratory psychology (junior year) at Cornell University. The instrument employed during the past three years has been, not the watch, but Politzer's acoumeter (as supplied by Meyrowitz). The acoumeter gives a 'ting' or chirping tone which is said to be that of the c^2; we have not verified the pitch of our instrument.[1] At any rate, it gives a tone; and this tone has never refused to fluctuate. Secondly, Eckener had used as stimuli, in work upon the fluctuations of attention, (1) the fall of a fine stream of sand upon a vibrating steel tongue, which (as he says expressly) "einen hellen, singenden Ton erzeugte," and (2) the buzz of the Wagner ham-

[1] See the description in A. Politzer, *Lehrbuch der Ohrenheilkunde*, 3d ed., 1893, p. 108. S. Rowe, in *The Physical Nature of the Child*, 1899, p. 27, speaks of the acoumeter as giving a "tap on wood." We are not familiar with this form of the apparatus.

mer of an induction-coil, which must also have had a distinctly tonal character. Fluctuation occurred with both stimuli.[1]

In view of this discrepancy it seemed worth while to make a fairly extended series of experiments upon the question.

(1) *Sample of Results Obtained with the Politzer Acoumeter.*— We may preface the account of these new experiments by citing the results of two series taken with the acoumeter. The instrument is kept tinging at as constant a rate as possible (about 4 tones to the 1 sec.); the observer indicates disappearance and reappearance of the sound by finger movements; a third person, seated with a stop-watch (fifths of seconds) before him, well beyond the range of the observer's hearing, takes the time record.

TABLE I.

Stimulus: acoumeter. Duration of expt.: approx. 1 min. Interval between expts.: 2 min.

OBSERVER.	NO. OF FLUCTUATIONS.	AV. TIME HEARD (SECS).	M. V.	AV. TIME LAPSED (SECS).	M. V.
C. A. P.	50	9.8	4.2	4.8	1.8
J. H. W.	25	11.2	4.5	4.4	.7

The observers of this Table had both had more than the usual amount of practice in drill-work. The times are, of course, worthless, as absolute values; the point of the experiment lay elsewhere. But they were obtained under good acoustic conditions, and with all the carefulness that the rough method allowed.

A control series, taken with the two observers simultaneously, gave, as it happened, no single case of coincidence of finger-signals. The cause of the fluctuation could not reside, therefore, in objective changes in the intensity of the stimulus.

(2) *Experiments with Tuning-fork Tone.* An electro-magnetic fork of 1024 v. s. (Koenig) was connected through a suitable resistance to a storage battery. The current was set, roughly, at the strength required just to keep the fork in constant vibration. The fork and its resonator were covered by a large wooden box, and this again muffled in several thicknesses of cloth. The observer was placed in a corridor of the laboratory in a straight line with the sounding fork, and at a distance of 20 to 40 m., as circumstances demanded. Behind the fork, in a different room, a Ludwig kymograph was set up. A Jacquet chronometer wrote fifths of seconds on the drum, and an ordinary electro-magnetic time-marker, connected to a noiseless key under the observer's hand, recorded the fluctuations of attention. The noise of the clockwork was wholly

[1] *Untersuchungen über die Schwankungen der Auffassung minimaler Reize.* In Wundt's *Philosophische Studien*, VIII, pp. 358, 359.

inaudible to the observer. The muffled fork gave out a thin constant tone.

The position of the limen was first determined. Then the experimenter started fork, drum and chronometer, and signalled by a bell-stroke to the observer that an experiment had begun. The observer gave a short signal when he first heard the tone; then left the key-circuit open as long as he continued to hear it; closed the key when it disappeared; held the circuit closed until reappearance; and so on. A complete experiment lasted from 1.5-2 min.; but noises, inside or outside the building, frequently curtailed the periods. All work was done late at night or very early in the morning. No experimental series was carried to the fatigue-point.

A pause of 2-3 min. was allowed between experiment and experiment. During this interval the observer prepared his introspective record. All fluctuation-times were thrown out in which the moment of change coincided with an objective (sound in building, etc.) or subjective disturbance (coughing, need of changing position in chair, etc.). A few very short times were marked 'uncertain' by the observer: these were also discarded. Eckener's distinction of 'objective' and 'subjective' fluctuations came out clearly;[1] the objective were comparatively few in number, and all under 3 sec. duration. They were discarded for introspective reasons similar to those given by Eckener's observers. No time whatever was thrown out by the experimenter; the observer was sole judge. It fortunately never happened that there was any discrepancy between a drum-record and the introspective reconstruction of the experiment by the observer. Had there been, it was our intention to discard the whole experiment. Introspection was the one criterion of correctness.

The observers were Dr. J. O. Quantz (Q), and Messrs. W. C. Bagley (B), C. A. Perry (P), and J. H. Wilson (W). All fully understood the problem in hand, and were cognizant of psychological methods. The listening ear was turned directly towards the source of sound. B, Q and W closed the other ear with cotton-wool; P found this irritating, and therefore left the second ear open. The Table on the following page gives a summary of results.

Two control-series were made with two observers simultaneously, the fluctuation-curves being recorded by time-markers accurately adjusted to write together. Five experiments were taken with P and W: P gave 41, W 26 (subjective and objective) fluctuations. Four were taken with B and W: B gave 29, and W 33 fluctuations. The kymograph tracings

[1] *Op. cit.*, pp. 361 f.

TABLE II.

Stimulus: fork. Duration of expt.: 1.5-2 min. Total number of fluctuations for each observer: 100. Interval between expts.: 2-3 min.

OBS.	DIST. FROM FORK IN M.	AV. TIME HEARD (SECS).	M. V.	AV. TIME LAPSED (SECS).	M. V.
B	20-31	8.61	3.3	5.26	1.5
P	29-37	8.49	2.6	4.95	1.1
Q	31-37	9.10	2.9	5.51	1.4
W	23-38	7.87	2.4	5.41	1.5

show conclusively the general disparity of the two sets of fluctuations in each case. Coincidences are very occasional; and, even when they occur, are not always coincidences of subjective fluctuation. Hence there is no reason to doubt the conviction of observers and experimenter, that the fork did not vary in objective intensity during an experimental sitting.

(3) *Experiments with Tone of Blown Bottle.* Although the fact that tones fluctuate seemed to be fairly well proved by the foregoing experiments, we thought it well to test the matter further with other sources of sound. We began with one of the bottles of the Stern apparatus for continuous tone-change. The bottle gave, approximately, the c^1 of 256 vibrations. It was sounded steadily by a stream of air from the compressed-air tank belonging to the apparatus. It was covered by a wooden box, large enough not to interfere with the sounding of the tone; the box was muffled in cloth, as before.

We need cite only a single series: duration of expt. 1 min.

OBS.	NO. OF EXPTS.	AV. TIME HEARD.	M. V.	AV. TIME LAPSED.	M. V.
P	20	9.0″	2.4″	5.4″	1.9″

Similar results were obtained from P in other series, and also from a number of series with the observer W. A series of 10 expts. taken with P and W simultaneously showed the usual disparity, guaranteeing the objective steadiness of the bottle-tone.

We next made a few trials with the Galton whistle,—another of Dr. Heinrich's tone-sources. But, although we had about 45 m. of corridor at our disposal, we found it impossible, by any amount of muffling and door-closing, to get a satisfactory limen.[1] There were a few indications of fluctuation; but we can say nothing definite upon the matter. The squeaking chirp of the whistle is, however, so like the chirp of the acoumeter that there can be little doubt that the fluctuation would occur under the right acoustic conditions.

[1] These experiments were made so near the end of the academic year that we had no time to have a special 'soundless box' constructed, to take the instrument; we were forced to be content with the means of screening and muffling available at the moment. Next year we hope to be able to settle the issue finally, as regards the Galton whistle.

The question now arises: If tones fluctuate, as we have found them to do, how is it that so careful and practised an observer as Dr. Heinrich has been led to make a contrary statement? It is difficult to offer any suggestion. It is possible—despite the statement that the tone "auf der äussersten Grenze der Hörbarkeit" was "immer continuierlich und constant"—that Dr. Heinrich did not secure really liminal tone-intensities. It must be remembered that he was his own sole observer, so that an intercomparison of liminal distances was impossible. We found it an exceedingly nice matter, and one that called for a considerable degree of practice on the part of the observer, to determine the place of just-audible tone intensity. Our final method was to let the observer move to and fro until he thought he had found the limen; then to have him listen attentively for some 20 or 30 seconds; and then, if the tone was continuously audible (as generally happened), to push him out, little by little, until the real intensity-limen was obtained. Tones have a surprising carrying-power; and they are so sharply differentiated from the background of faint noise, against which they stand out, that the attention fastens to them easily and persistently.

There are, of course, other and considerable difficulties in the work. But Dr. Heinrich is probably as well aware of them as we are. He says explicitly: "Die Schwierigkeiten in der Beobachtung der Intensitätsschwankungen sind so erheblich, dass man immer längerer Uebung bedarf, um sie genauer verfolgen zu können" (p. 373). We need not enumerate these difficulties: we found nothing in any of them, whether technical or introspective, that could account for the divergence of results as plausibly as the suggestion thrown out above. We hope that Dr. Heinrich may be incited by our results to repeat his experiments upon a number of observers.

Summary.

We have found, in opposition to the statement made by Dr. Heinrich, that tones of liminal intensity, attentively followed by practised observers, evince the fluctuations ordinarily described as 'fluctuations of attention.' This rule holds of discrete (Politzer's acoumeter) and of continuous tones (tuning-fork, blown bottle). We were unable, under our laboratory conditions, to obtain a tone of the required minimal intensity from the Galton whistle.

PSYCHOLOGICAL LITERATURE.

Friedrich Nietzsche, Aphorismes et fragments choisis. Par H. LICHTENBERGER. Paris, F. Alcan, 1899. pp. xxxii, 181.

The author has put together in this little book some of the most striking parts of Nietzsche's work, under the following translated titles: *La naissance de la tragedie; Considerations inactuelles, choses humaines par trop humaines; Aurore; La gaie science; Ainsi parla Zarathustra; Par-delà le bien et le mal; La généalogie de la morale; Le cas Wagner; Le crépuscule des idoles; L'Antichrétien; Ecce Homo; Nietzsche contra Wagner;* and *Poésies;* not so much, he says, with a view of giving the reader an insight into Nietzsche's philosophy, as of presenting the philosopher "as a man, as a personality, as a poet." He would have his author appreciated for his moral nobility, and for his style as a writer, even if condemned as an illogical thinker.

A short sketch of Nietzsche's life is given, and the attempt made to show its harmony and, at bottom, its health physically and mentally up to the very moment of the great catastrophe which left him hopelessly insane. Complex as Nietzsche's mind seemed to be when analyzed, it nevertheless formed a unity. There was no internal struggle, no "anarchy of instincts," a sure sign of degeneracy. His views change radically, to be sure, in the course of his life. He loses his early Christian faith, and later his allegiance to the philosophy of Wagner and Schopenhauer; but the whole is an evolutionary, rather than a revolutionary process.

The development of Nietzsche's philosophy is also briefly reviewed. A positive and a negative tendency manifest themselves all through his life. Sometimes the one and sometimes the other has the ascendency. The positive element is one of enthusiasm, causing him to love, admire, reverence. The negative element, even more powerful, is critical, the result of the sincerity of his nature.

He passes from his crusade against scientific optimism, where he calls to aid Schopenhauer and Wagner, to a direct denial of his former position. M. Lichtenberger thinks it is a significant fact that this takes place at the time when he is physically struggling against disease, and attributes the outcome largely to the fact that the philosopher is essentially a sound man.

All the principal facts of Nietzsche's thinking are similarly dealt with, and are made fairly clear.

At the beginning of each 'fragment' is a short résumé of the whole article, and a statement of the special conditions under which it was written.

The book is appetizing. No one can read it and be content. A more simple and direct way to create an interest in Nietzsche and his works can hardly be conceived.

The Physical Nature of the Child, and How to Study it. By STUART H. ROWE, Ph D. New York, The Macmillan Co., 1899. pp. xiv, 207.

The great practical good that has come from the study of children is, after all, the creation of a certain attitude toward them. This attitude is well brought out in Dr. Rowe's *The Physical Nature of the*

Child, and How to Study it. Such a book could not have been written ten years ago; there was no material of which to make it. And even if written, it would not have been read; there was no interest in the subject.

This book *will* be read; yet one who has kept in touch even superficially with what is being discussed in the current educational magazine, especially in the *Pedagogical Seminary*, gets from it not a single new idea.

This does not mean that the book is not full of thought, and of good thought. It is a volume that ought to be in every Normal School library, and might profitably be read by the great majority of the teachers of the country. Less technical than its title seems to indicate, it deals with the general conditions of a child's life both at home and at school, as well as with the care of sight, hearing, touch, etc.

The book is emphatically 'common sense.' The author shows an acquaintance with much literature on his subject, and uses his material for the benefit of the every-day teacher in the every-day school. Many of his "tests" for sense defects are, as he frankly acknowledges, crude. Much that he says is common-place; but for that very reason, sandwiched in with less apparent truths, is valuable and forcible. For instance, he calls attention to the spread of disease by means of the common-drinking cup and the common towel; facts that every teacher ought to know and frown upon, but which still exist in all their primitive nastiness. There is no attempt at scientific accuracy, but when science is thought to point the way she is followed. The chapter on *Growth and Adolescence* is, perhaps, the most valuable of the work.

The book is clearly written and is paragraphed in sub-heads in a way to catch the eye. At the end is a rather long bibliography, largely made up of American educational magazines, followed by a good index.

Die moderne physiologische Psychologie in Deutschland. Eine historisch-kritische Untersuchung, mit besonderer Berücksichtigung des Problems der Aufmerksamkeit. By W. HEINRICH. Zürich, E. Speidel, 1899. pp. vii, 249. Mk. 4.

The second edition of this brilliant but one-sided little book has been enlarged by a section dealing with Exner's *Entwurf*, a concluding chapter, and an appendix replying to criticisms by Külpe and Hillebrand; while the section on Wundt has been considerably modified. The revision shows all the dogmatism of the previous edition; there is the same arbitrariness in the selection and omission of books and authors, and the same incapacity to envisage a psychological system as a whole. But if the author is a gadfly, he is one that cannot be all too easily brushed aside. His objections and reproofs must be met, and met by hard thinking. For this reason the work is most welcome. It may, perhaps, be hoped that in yet another edition Dr. Heinrich will extend the range of his vision and consider French and American theories of attention.

Untersuchungen ueber das Gedächtniss für räumliche Distanzen des Gesichtssinnes. ZWETAN RADOSLAWOW-HADJI-DENKOW. *Philos. Studien* XV, 3. pp. 318-452.

This article is based on experiments carried on in the Leipzig Laboratory in 1896-7. It attempts to answer two questions, viz.: (1) What is the exact influence of time on visual memory for distances? and (2) what effect upon the memory proceeds from the character of the filling introduced into the interval of retention?

(1) After citing the work of E. H. Weber, W. Lewy and J. Cĕlikov on visual memory the author sets forth the relation which obtains

between the quantitative accuracy of memory (Gedächtnissschärfe) and the length of the memory interval. He used as stimulus a lateral distance (usually ca. 30 mm.) limited by two black dots, one of which was attached to a framed pane of glass, and the other to a white card immediately behind the glass, and adjustable laterally by means of a micrometer screw. The method of minimal changes (without knowledge of direction) was used throughout (except one series by R. & W. cases). Values for both the upper and lower limina were obtained with 13 intervals (1″ to 60″). It was found that "within certain limits the accuracy of memory [indicated by the magnitude of the limina] is approximately proportional to the logarithm of the time:" this for normals of 30 mm. and 40 mm. Small irregularities on the logarithmic curves are referred to accidental coincidences of the stimulation time with various phases of the attention wave. Large irregularities—lowering of the limen—(similar to H. K. Wolfe's: cf. *Ueber das Gedächtniss*) give expression, in the author's opinion, to a peculiarity (bestimmte Eigenschaft) of the memorial function: they indicate an intermittent strengthening of the memorial image (446). The most apparent lowering of the difference limen occurs after 30″. (2) In previous experiments the direction of the attention was not controlled during the retention interval, though the eyes were closed and the observers declared that the image of the normal stimulus was seldom present: to estimate accurately the effect of the conscious filling of the interval, various forms of stimulation—metronome and bell strokes, grays, colors and reading (Zwischeneindrücke)—were introduced when the normal was removed. It was found that, under these conditions, the memory, instead of falling off, improved—$\triangle r$ for the various intervals decreased.[1] This "unexpected" result the author explains as follows. Just as a perception is dimmed by a stimulus acting continuously for a long time, memory suffers if a single idea is steadily held in the attention. But if the attention is held away (by Zwischeneindrücke, *e. g.*) from the memorial contents, the latter remains clear and fresh. The withdrawal of the attention, he conjectures, means that the psychophysical energy is left undisturbed in the memory center (369), and hence that the memory, as a cerebral disposition is kept intact. A constant reproduction, on the other hand, exhausts the psychophysical energy, and memory is weakened. Three objections may be offered to this rather tenuous explanation. (1) The obscurity noted in perception is very likely to be due to peripheral processes which are not in evidence in the case of memory. (2) According to the introspection of the subjects, as indicated above, the idea of the normal "never or only rarely, and then very indistinctly" (449) appeared in consciousness during the interval. Indeed, the author asserts that the two incentives to reproduction are (*a*) the comparison-stimulus and (*b*) eye-movements accompanying its appearance (450). (3) It is extremely doubtful whether the Zwischeneindrücke—sounds, colors, etc.—furnished an adequate distraction: even addition has been found to produce only a partial and intermittent abstraction.[2] Probably these heterogeneous sensations (unless some unrecorded precaution was taken) really acted as a spur and kept the mind alert.

The fact that a j. n. d. becomes subliminal on the increase of the

[1] N. Vaschide has remarked that distraction favors memory for lines. *Dritter Intern. Cong. für Psych.*, p. 455.

[2] Cf. A. J. Hamlin who remarks that an intermittent distraction is no distraction, for it is the degree and not the duration of the attention that affects the judgment in S. D.: in fact, "the so-called distraction . . . . . by adding definiteness and interest to the task heightens the degree of attention." *Attention and Distraction*, pp. 5 ff.

retention interval (as the logarithmic curve shows) leads R-H-D to a distinction between *ideal* and *absolute* memories. In the former, a j. n.d. would remain liminal through any interval of time; in the latter, supraliminal differences beyond a certain magnitude are retained through an indefinite lapse of time. The author argues, from the memory curve, that an ideal memory is an impossibility, and also that all memory limina (*i. e.*, difference limina at the various intervals) lie below absolute memory, *i. e.*, between ideal and absolute memory, but approach the latter as the time interval increases. The contraction of an ideal memory was guarded against in the experiments by a daily shifting of the normal stimulus; but since it was found that the constant use of a single normal throughout a working period did not tend to develop it, the author concludes that the precaution was useless. This is significant, since it seems natural that the direct effect of practice (as *e. g.*, the repetition of an N in the method of average error) should be the formation of a stereotyped memory that would carry a liminal difference through an extended lapse of time;[1] that is, tend to produce an ideal memory. In fact, one of R-H-D's subjects shows plainly such a tendency. Tyszko (408) takes first a series beginning at the 60″ interval and running down to 1″. The liminal values (average of o.L. and u.L.) are for 60″—1.235 mm.; for 1″—.46 mm., while a second series taken in the opposite direction gives the values: for 1″—.45 mm.—; for 60″—.675 mm.

The limit of absolute memory (Grenzunterschied) was found by getting the limina at a constant short interval through which the subject observed a lateral distance (Zwischendistanz) = or ≷ the normal. As this distance approached the normal it disturbed the limen by (1) obliteration of the memory image of the normal, and (2) by confusion with this image. As it receded from the normal (becoming greater or less) its disturbing influence on the latter ceased at a certain point, which represents for the author the lower limit of absolute memory; *i. e.*, the smallest difference which persists indefinitely (presupposing a constant degree of practice). It is clear that this method will be valid only where no qualitative change of the memorial residue is brought about through time; moreover, it does not seem to follow that the confusion due to an interpolated stimulus, lasting for 10″ or 20″, would be equivalent in its effect upon the limen to an ordinary interval of indefinite length. The coincidences given in the text are too rough (if we accept the logarithmic form of the memory curve) to be convincing.

Finally, the author notes that two objectively equal stimuli, when given successively, tend to elicit the judgment "greater." He decides that this overestimation of the second stimulus is due to a peripheral factor and not to a change in the memory image, as has often been held in similar cases.[2] The peripheral influence — variable muscular strains —is shown very ingeniously to be an indubitable cause in the overestimation. It does not, however, explain an almost constant disparity in the magnitudes of the upper and lower limina: the lower is in almost every case smaller. For this there is found no satisfactory explanation (353). The reasons brought against the lack of fidelity of the image are too involved to be discussed here. They seem to the writer to be insufficient. Our own reason would be that no memory image has been shown to exist in the experiments in question. The author states that often a feeling seems to be the only warrant for the assurance experienced with a judgment of likeness or difference. May

[1] Cf. pp. 35-6 *supra*.
[2] Note p. 36, *supra*.

it not be that this feeling replaces the explicit comparison between the perception and the image and itself validates the judgment?

I. M. BENTLEY.

A Primer of Psychology. By EDWARD BRADFORD TITCHENER. The Macmillan Co., New York, 1899, pp. xvi, 316.

The first edition of this admirable introduction to Psychology has already been noticed in the JOURNAL (vol. X, p. 150). The new edition has been thoroughly revised, several sections having been rewritten in whole, or in part, and an appendix has been added giving a résumé of Flechsig's scheme of cortical centres. The scope and general treatment of course remains unchanged.

NOTES AND NEWS.

THE PARIS CONGRESS.

The programme of the fourth International Congress of Psychology to be held in Paris August 20-25, 1900, is to hand, and gives the following details of organization.

Intending members are requested to fill out a printed form (obtainable from the American members of the International Council: Professors Baldwin, Stanley Hall, James and Titchener), and to forward it with 20 fr. membership fee to the general secretary, M. le Dr. Pierre Janet, 21 rue Barbet-de-Jouy, Paris. The card of membership entitles its holder to all the publications of the Congress, and also gives right of entry to various laboratories, museums, hospitals, etc. Railroad reductions of 40 per cent. are expected during the exposition. Communications may be written in English, German, French or Italian; no communication must exceed 20 minutes in duration. Titles of communications are desired, at the latest, by Jan. 1, 1900. Sections and presidents are as follows:

I. *Psychologie dans ses rapports avec l'anatomie et la physiologie.* Dr. M. Duval.
II. *Psychologie introspective dans ses rapports avec la philosophie.* M. G. Séailles.
III. *Psychologie expérimentelle et psychophysique.* M. A. Binet.
IV. *Psychologie pathologique et psychiatrie.* Dr. Magnan.
V. *Psychologie de l'hypnotisme, de la suggestion et questions connexes.* Dr. Bernheim.
VI. *Psychologie sociale et criminelle.* M. Tarde.
VII. *Psychologie animale et comparée, anthropologie, ethnologie.* M. Y. Delage.

A local committee of reception, including thirty well-known names, has been formed: we regret to record the fact that Professor Balbiani has died since the list was prepared. The officers of the Congress are: President, Professor Th. Ribot; Vice-President, Professor Ch. Richet; General Secretary, Dr. Pierre Janet; and Treasurer, M. Felix Alcan.

Information concerning related Congresses may be obtained as follows: Philosophy, M. Xavier Léon, 39 rue des Mathurin; Social Sciences, M. Dick May, 22 rue Victor Massé; History of Religions, MM. J. Réville and L. Marillier, Sorbonne, Paris.

PSYCHOLOGICAL CARD CATALOGUE.

The following circular has been sent out by Prof. James H. Leuba, of Bryn Mawr College:

A card catalogue of articles on Psychology and Related Subjects contained in periodicals for the years 1860-1899.

To prevent the grievous waste of time suffered year after year by psychologists in looking up the literature of the particular subjects on which they may be engaged, and to bring to their knowledge the wealth of material consigned to, and in large part buried in, the numerous periodicals containing psychological material, the undersigned has prepared a card catalogue of the articles bearing upon psychology contained in the following periodicals, beginning with the year 1860, or with the first volume of the periodical, and including 1898, unless otherwise indicated in the list:

Philos. Studien; Zeitschrift f. Psy.; Arch. f. Syst. Philos.; Vierteljahrss. f. wissenschaftliche Philos.; Zeitschrift f. immanente Philos.; Zeitschrift f. Philos. and philos. Kritik.; Philos. Jahrbuch (Vol. 4-7); Zeitschrift f. Philos. and Pädagogik; Zeitschrift f. Hypnotismus; Psy. Arbeiten; Münsterberg's Beiträge; Mind; Proc. Soc. Psy. Research; Amer. Jr. Psy.; Psy. Review; Rev. philosophique; Année psychologique; Rev. de Metaphysique et de Morale, Rev. de l'Hypnotisme; Rev. neo-scholastique (Vol. 3-5); Studies of the Yale Psy. Laboratory; Intern. Jr. of Ethics; Monist; Science (from beginning); Nature (from beginning); Amer. Jr. of Science (from beginning); Pop. Sc. Mo. (from beginning); Proc. Roy. Soc. (from beginning); Philos. Mag. (from beginning); Phil. Tran. (from beginning); New World; Brain; Jr. of Mental Science (1863-1898); Amer. Jr. of Insanity; Allg. Zeitschrift f. Psychiatrie; Bull. de la Soc. d'Anthrop. de Paris (Vol. 1-6, 1st Ser., and Vol. 1-9, 3rd Ser.); L'Anthropologiste; Rev. mens. de l'Ecole de l'Anthrop.; Arch. de l'Anthrop. criminelle; Amer. Anthrop.; Jr. of Amer. Folk-Lore.

It is hoped that the catalogue will be made practically complete at some future time by the addition of the contents of a number of other periodicals.

The catalogue numbers about 10,000 cards. We have frequently gathered on one card references to several articles on one subject by different, or by the same author, so that the number of articles indexed surpasses considerably the number of cards.

Our endeavor has been to keep the catalogue free from matter extraneous to its purpose and, at the same time, to include in it everything having a clear bearing upon psychology taken in a wide sense. For this reason a majority of the papers which would come more directly under the heads metaphysics, ethics, and logic, have found place in it.

We have excluded the reviews of books, with a few exceptions; the papers on the history of philosophy; the reports of institutions, congresses, etc., except when of particular value; and the discussions of consequence to the author's only.

The classification is by subjects arranged in alphabetical order. The general heads are divided into as many subdivisions as seems useful. To facilitate the use of the catalogue a large number of cards have been classified under several heads by means of cross reference cards. Special care has been taken in this matter so that the answers of the catalogue to the person consulting it may be prompt and to the point.

The card system makes it possible to keep the catalogue up to date, year by year, without more trouble than the cutting and pasting, on cards of the proper size, of the titles indexed in the excellent bibliography issued yearly by the *Psychological Review*. (Published since

1894.) The cards used are supplied by the Library Bureau, which has branches in the larger cities of Europe as well as in this country; thus uniformity of size and of material can easily be maintained.

We are now endeavoring with the collaboration of several psychologists to add short annotations to the cards, though the difficulty and the magnitude of the task may compel us to give it up, in part at least.

The cost of the catalogue described in the circular, if printed, would be beyond what most colleges and universities could afford to pay, but, if a sufficient number of subscribers were found, mimeographed copies in the clear hand known as "Library Hand" could be furnished at the price of from $40 to $50, according to the number of subscribers.

You are respectfully requested to let the undersigned know, at your earliest convenience, whether you desire a duplicate at that price. Copies ordered subsequently and having to be executed singly would, of course, cost a great deal more.

JAMES H. LEUBA, Ph. D.,
Bryn Mawr College,
Bryn Mawr, Pa.

BOOKS.

Professor James' *The Will to Believe* is in course of translation into German, and Professor Baldwin's *Story of the Mind* into French and Italian.

The first volume of Professor Titchener's *First Experiments in Psychology* is announced for January. It will contain about 50 qualitative experiments, worked through in minute detail, with references to literature and apparatus, additional exercises, directions for recording, etc., etc. The instruments required for the course will be furnished by the Chicago Laboratory Supply Co.

PERSONAL.

We regret to record the deaths, on July 31, of Dr. D. G. Brinton, Professor of American Archæology and Linguistics in the University of Pennsylvania, and, on June 14, of Professor N. Grote, of the Moscow University, the distinguished editor of *Voprosy philosophii i psychologii*, and President of the Psychological Society of Moscow; as well as that of M. Balbiani, Professor of Comparative Embryology in the Collège de France, mentioned in a previous Note.

Professor Max von Frey has been called from Zurich to fill the chair of physiology vacant at Würzburg by the resignation of Professor A. Fick. With von Frey, Külpe, Marbe and Schenck, Würzburg should become a psychophysical centre of first-rate importance.

Professor J. M. Baldwin has been given a half year's leave of absence from Princeton University, to see the Dictionary of Philosophy and Psychology through the press in England. His courses at Princeton will be in the hands of Professor H. C. Warren.

During Professor Armstrong's absence from Wesleyan University the department of philosophy and psychology will be in charge of Associate Professor R. Dodge.

Dr. A. Kirschmann has been appointed Professor of Philosophy and Director of the Psychological Laboratory in the University of Toronto.

BOOKS RECEIVED.

CARPENTER, GEORGE H. Insects: Their structure and life. A primer of entomology. J. M. Dent & Co., London, 1899. pp. 404.

HALDANE, E. S. James Frederick Ferrier. (Famous Scots Series.) Imported by Charles Scribner's Sons, N. Y., pp. 158. Price, 75 cents.

HEINRICH, W. Die moderne Physiologische Psychologie in Deutschland. Eine historisch-kritische Untersuchung mit besonderer Berücksichtigung des Problems der Aufmerksamkeit. E. Speidel, Zürich, 1899. pp. 249. Price, 4 marks.

HEINRICH, W. Zur Prinzipienfrage der Psychologie. E. Speidel, Zürich, 1899. pp. 74. Price, 2 marks.

LICHTENBERGER, HENRI. Friedrich Neitzsche, Aphorismes et fragments choisis. Félix Alcan, Paris, 1899. pp. 181. Price, Fcs. 2.50.

Morale Sociale. Leçons professées au collège libre des sciences sociales. Préface de Emile Boutroux. Félix Alcan, Paris, 1899. pp. 318. Price, Fcs. 6.

PATRICK, MARY MILLS. Sextus Empiricus and Greek scepticisms. George Bell & Sons, London, 1899. pp. 163. Price, 5 shillings.

SNIDER, DENTON J. The will and its world. Psychical and ethical. Sigma Publishing Co., St. Louis, Mo., 1899. pp. 575. (For sale by A. C. McClurg Co., Chicago, Ill.)

TIENES, GEORGE A. Nietzsche's Stellung zu den Grundfragen der Ethik genetisch dargestellt. Reprint from Berner Studien zur Philosophie und ihrer Geschichte. Band 17. C. Sturzenegger, Bern, 1899. 50 pages. Price, 1.75 marks.

MIND: NEW SERIES.

A Quarterly Review of Psychology and Philosophy.

Edited by G. F. STOUT,

With the co-operation of PROFESSOR H. SIDGWICK, DR. E. CAIRD and PROFESSOR J. WARD (England); PROFESSOR TITCHENER (U. S. A.)

MIND is the only periodical which represents the interests of Philosophy and Psychology in England. Its general aim is to afford a vehicle for the expression of all that is most original and valuable in current English thought, without distinction of School or Department of Philosophical Inquiry.

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In each number at least three books are selected to receive full *critical notice* by experts on the subjects of which they treat; while under the head *New Books* is given a general account of the aim and contents of all recently published works of any importance which are within the scope of the Review.

There also appears, under the head *Philosophical Periodicals*, a list of the titles and an indication of the contents of the articles in the leading philosophical journals, English and foreign, with a further notice of those which appear to be of special importance. *Notes* on recent researches and current news conclude each number.

All communications to the editor from Europe should be addressed to: G. F. STOUT, *The University, Oxford;* those from America to E. B. TITCHENER, *Cornell University, Ithaca, N. Y.*

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THE AMERICAN

JOURNAL OF PSYCHOLOGY

Founded by G. STANLEY HALL in 1887.

Vol. XI. JANUARY, 1900. No. 2.

AN EXPERIMENTAL STUDY OF THE MENTAL PROCESSES OF THE RAT.

By WILLARD S. SMALL,
Fellow in Psychology, Clark University.

The studies presented in this paper are concerned solely with the mental life of the white rat, the albino sport of the common pest, *mus decumanus*. The white rat exists, so far as I am able to learn, only in captivity, and so, though especially suited for laboratory study, may be expected to present some slight variation from its wild congeners. No apology is made, however, for this limitation, for the writer feels that at present the greatest need of Comparative Psychology is the careful description of the psychic life of special animal forms. Generalizations will come in due time.

Work of this kind has already been done by several investigators in various phases of comparative psychology, the most systematic studies of vertebrates being those of Dr. Thorndike in the Columbia laboratory, and of Dr. Kline in the Clark laboratory.[1]

The chief difficulty of such experimentation lies in controlling the conditions of the problem without interfering with the natural instincts and proclivities of the animal, and thus distracting or deflecting its attention. "An animal should be made to do difficult things only in the line of its inherent abilities."[2]

[1] Thorndike: Animal Intelligence, Psy. Rev. Monographs, No. 8. Kline: Methods in Animal Psychology, *Am. Jour. Psy.*, Vol. V, No. 2; Laboratory Course in Comp. Psy., *Am. Jour. Psy.*, Vol. V, No. 3. Morgan, Mills and others have, of course, made experiments of great value, but for the most part of a more informal character.

[2] Ernest Ingersoll: Wild Neighbors, p. 179.

The experiments described in this paper are a part of a series carried on in the Clark laboratory in the academic year 1898-99. Their primary purpose was to study the character of the associative processes of the rat; *pari passu* with which, however, would necessarily go a study of the general character of its intelligence as conditioned by its dominant instincts, structural and functional traits, affective life, etc., as well as by the form of the associative processes—indeed as basal to them. The word association is used broadly to cover all possible connections of mental elements as indicated by the activities of the animals. Wundt's definition of association as "ideational connections which do not exhibit the characteristics of the activity of logical thought" might serve in this case with the more general phrase "connections of mental elements" substituted for "ideational connections." Wundt's definition is useful as a description of the upper limits of association.

The experiments described fall into six groups. All of them bear upon the problem of the manner in which contiguous associations originate and are integrated; upon the persistence of such processes; and the factors entering into them. Other points studied are variability of the association after it is formed, recognition and discrimination, imitation, and individual differences.

The diary, extracts from which are contained in the following pages, was made while the observations were in progress, and so records the impressions while they were "hot." Interpretative conclusions, tentative in most cases, are advanced here and there. This method of presentation is believed to be the most fruitful under the circumstances.

GROUP I. This group of experiments was the original point of departure for all the succeeding experimentation. It was undertaken merely as a study in method in comparative psychology for the laboratory, based upon the general principles of such study as enunciated in the introductory section. The most definite point in view was to test the rat's peculiar modes of activity in the process of forming definite associations within the scope of its natural mental experience; the rapidity with which such formations are perfected; their stability and permanence, and, in general, to get a more accurate knowledge of the kind of intelligence possessed by the rat. It will be seen, then, that the aim was comparative in the exact sense, as well as structural. Indeed the structural aim was subsidiary.

The most natural motive to play upon in such experimentation is hunger. This furnishes the best dynamic for mental procedure. The rat is no exception to the reign of the nutritive impulse.[1] On the active side digging was selected as a

[1] I trust the reader will not "jump" to the conclusion that no other

characteristic instinctive activity in the free life of the rat—as was clearly apparent in the writer's Study of Psychic Development.[1]

The apparatus used was a cubical box of 6-inch dimensions. The sides were of ¼-inch wire mesh; the bottom of wood ⅞-inch thich; and the top of glass. In the front side of the bottom was a hole large enough to admit a rat. The bottom was raised 1½ inches from the floor of the cage by strips of wood on the sides of the bottom. In experimentation the food was put inside the box, and sawdust was banked around the box to the top of the floor, completely concealing the entrance. This will be spoken of as Box I; two series of experiments were made with it upon two pairs of rats. The experiments were performed in the cages[2] where the rats were usually kept. At the regular time for feeding, Box I, containing food, was placed in the cage and banked up with sawdust. Before the experiments were begun Box I was left open in the cage for several days that the rats might become perfectly familiar with its appearance. Their timidity makes such precaution advisable.

Series I. Rats I and II (both females). The series consisted of 13 experiments, on successive days. The selected examples[3] which follow show the results of the series. The notes were made always while watching the experiments.

Experiment 1. Both rats attacked the box at once. They crawled all over the box, and went round and round it monotonously. Sniffed continually. After an hour of persevering effort they began to get discouraged; their movements becoming haphazard and indifferent. One gave up and returned to the nest. The other, more frisky, soon began scratching about instinctively. The hole thus accidentally dug happened to be in the right place. The rat immediately poked its nose into the new opening which was not large enough to admit its head. It then ran away as if frightened, but soon returned, sniffed cautiously at the hole, dug away more sawdust, and then scampered away again. These acts were repeated several times, till a large opening was made. The rat then entered cautiously, snatched a piece of food and carried it into its hiding place in the corner of the cage. Time, 1 hr. 30 m.

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motive would be workable. Hunger is merely the most fundamental and most surely-to-be-relied upon.

[1] *American Journal of Psychology*, XI, 1899, 80-100.

[2] Cage as follows: Dimensions in inches. Length, 20; height, 16; width, 16. Floor, back, and top of wood; front and one end of glass; other end, wire mesh (¼-in.) for ventilation. Floor is covered with sawdust.

[3] A detailed account of the first five of this series may be found in Kline's article: Methods in Animal Psychology, *Amer. Jour. of Psy.*, Vol. X, No. 2, p. 277. I quote in part from that account.

Experiment 2. Actions similar to those of the preceding day, except that they spent more time near the place excavated yesterday, seeming to have located the right place indefinitely. After four minutes of frisking and fidgeting one began digging with a will, not stopping till the work was completed. As before, they did not enter at once, but frisked about nervously —peering into the hole, scuttling away and sniffing for some minutes. Time, 8 m.

Experiment 3. Rats began work immediately, and confined their efforts to movements about the right place. Sniffed around for a minute and a half, then one began to dig, and completed the task in one-half minute. No hesitation about entering. Time, 2½ m.

Experiment 5. Only one rat came out. Approached the box leisurely, sniffing the air as she went. Stood erect, with forepaws against the box. Suddenly dropped down and began digging. When half done, stopped, walked away, returned and finished the work. Entered and took food. Time, 3½ m.

Experiment 13. Most of the useless movements have been dropped. There seems to be a pretty definite idea of what is to be done. Time, 30 sec.

The features of the series were the rapid reduction of the time required to get into the box, the elimination of most of the useless preliminary movements, and the apparent definiteness of the movements at the end of the series. The time required was reduced from 1 hr. and 30 m. the first day, to 8 m. the second day, and so on gradually to 30 sec. the last day. At the fifth trial, however, the associative process seemed very insecure. The rats had not learned to dig at exactly the right place, nor did they dig at all till they had examined the box several times; but at the end of the series they had definitely located the point of attack, and associated that with the appropriate movements, so that if *very hungry* they would begin immediately to dig in that spot. The nervousness relative to entering the box after the excavation had been made, so apparent the first few days, disappeared entirely about the sixth day. The actual time relations of the series are given in Table I.[1] It will appear from this table and from other tables that the time relation will not serve as an exact index of the definiteness and certainty of the mental process thus figured.[2] It does give, however, a general index, if the relation considered be that of one experiment to the whole series, not to the next consecutive experiment.

Series II. Rats III and IV. The conditions and apparatus were exactly as in Series I. Both rats were females.

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[1] See tables at the end of the article.

[2] For this reason I have not plotted any time curves.

Experiment 1. The rats worked at intervals for 35 m., when they got the food. They dug very little at a time. At no time did they become aware that the sawdust was the obstructing object. They were not quite so vigorous in their efforts as I and II had been.

Experiment 2. They dug in in two and a half minutes.

Experiment 3. After the usual preliminary sniffing they dug in. The movements were not very vigorous, and they did not confine their efforts to the objective point. Rather, they dug promiscuously along the whole side of the box, showing that the place of entrance is not located.

Experiment 4. Secured the food in one minute.

Experiment 6. One rat went at once to the right spot and dug four or five strokes. Tried then to enter, but stuck half way. Withdrew head and finished the excavation in a most business-like way. Time, 30 sec. The other rat did no digging, but tried to steal her industrious comrade's hard-earned food. Failing in this she came to the hole, but did not enter. Ran back and again tried to steal, evidently not realizing at all the significance of the hole—or perhaps a safer suggestion would be that the certainty of the piece in the other rat's possession distracted her from making exploration. After about 1½ m. scuffling she came again to the box and got the remaining piece of bread.

Experiment 8. Did not begin work for nearly a minute. Then went directly to the right place. The sawdust was piled a little higher than usual. The "leading" rat went once around the box, as if looking for an easier place. Came back and dug in. Actual time, ½ m. The other rat tried, for several minutes, to steal her mate's food before going to the box.

Experiment 9. Delay of ten minutes before leaving the nest. Then dug in in a few seconds.

Experiment 10. Both rats very hungry. Hardly waited for me to close the box; sniffed and tried to get in while I was banking the sawdust. Into the box with a few strokes. Time, 10 sec. The second rat is not so sharp. First tried to steal the bread from her mate; then poked her head into the hole, but did not find the bread, as it was in the opposite corner. She then alternated for some minutes between fighting with her mate, and digging at the corner inside of which was the other piece of bread. This suggests that this rat does not associate the *whole of the box* with the food. It may be that the association in the case of the other rat is between *digging at a special place* and getting the food, the visual image of the box as a whole having a very unimportant rôle in the process. The second rat finally got the food from her mate. This one returned at once to the box and got the other piece.

Experiment 13. The "leading" rat instantly attacked the right place, and dug in with a few well directed strokes. Not a false or unnecessary movement. Time, 10 sec. The other rat stole her mate's bread. The latter returned immediately and got the second piece.[1]

Experiment 18. Neither rat attempted to get the food. They walked idly around the box once or twice, then went to their nest and lay down.

Experiment 19. Rat III went immediately to work—apparently very hungry. She dug half-way in, and then paused and ran around to the side of the box, as if to see whether the food were there. Back, and in. Sniffed both pieces of bread; took the larger.

Examination and comparison of these two series of experiments, made under conditions as nearly identical as possible, yield some interesting results. (a) It was not remarked in the course of Series I, that only one of the rats had learned to perform the task. This was observed in the course of Series II, and proven after experiment 13. There is no doubt, however, that the same is true of the rats in Series I, as was confirmed later. The significant thing about this fact is the reflection it casts upon the imitative faculty of the rat. Rat IV must have seen Rat III make the excavation and enter for the food, but she did not imitate the action. The action and the end were not inferentially associated. This fact limits, but does not exclude imitation. (b) The time factor in the two series shows marked differences. Under identical conditions the rats in Series I required for experiment 1 more than double the time required by those in Series II—90 and 35 m., respectively; and a similar difference appears in following down the table, noting the relative celerity with which the association becomes definite and stable: in Series I the minimum time is 20 sec., reached in experiment 13; in Series II the minimum is 10 sec., reached in experiment 10, the minimum of Series I, 30 sec., being reached in Series II in experiment 6. (c) The immense importance of the first success is brought into relief by the drop in time from the first to the second experiment in both series, 90 m. to 8 m., and 35 m. to 2½ m., respectively. (d) The irregularity of the time factor after the rats had learned the task is noteworthy. In Series II, *e. g.*, the variation is from 10 sec. to 40 sec. after experiment 9, when the task was fully mastered. This variation is due to several causes, probably, the

[1] Being pretty well convinced that the same rat was doing the work each time, I now marked the rats so that they were easily distinguishable. I designate them hereafter III and IV, III being the one that had solved the problem.

most apparent of which are variations in appetite, and the normal "flightiness" and timidity of the rat.

GROUP II. In purpose and execution this group of experiments coincides with Group I. As, in that case, the end aimed at was a carefully controlled observation of the *modus operandi* of the rats in solving a problem easily within their capacity, and without inhibiting or distracting influences. The difference lies in the instinctive activity appealed to, gnawing instead of digging, and the adaptation of apparatus to that activity. There is also a further slight difference in the conditions, in the substitution of the new piece of apparatus, similar in appearance to that with which they were already familiar. This tests incidentally their power of recognition and discrimination—the same rats being used.

The apparatus used in this group, and designated Box II, was as follows: Form, material and dimensions, the same as Box I. The only difference is that the entrance is a small opening, two and one-half inches square, on one side. This opening is provided with an inward swinging door of sheet zinc swung from the top. The door and the top of the cage are connected by a strong rubber band, so that the door, when free, is held open. The door is closed securely by means of narrow strips of stout paper stuck, with sealing-wax, to the door and the lower edge of the box. Admission to the box can only be had by removing the obstructing papers.[1] This might be effected in several ways, by scratching, biting, or pulling the paper off, or even by butting the door in with the nose. It was expected, however, that biting or gnawing would be resorted to in most cases, as this would be the easiest method.

Series I. Rats I and II. Previous to the experimentation recorded in Series I of Group I a few tentative tests had been made with Box II upon a pair of rats; one of which was *Rat I or II* of the later experiments. The results of this experimentation were so unsatisfactory that the method was abandoned temporarily.[2] This was eighteen days before the beginning of this series. A brief résumé of these abortive experiments and suggestions as to the reason of their failure is given in the foot note below.[3] They have a positive value in showing how im-

[1] This box was also described in the *Am. Jour. of Psy.*, Vol. X, 1899, p. 426.

[2] *Am. Jour. of Psy., loc. cit.*

[3] For several days before the experiments were begun, Box II had been left in the cage with the rats. The door was left open so that the rats might become fully acquainted with the apparatus, thus eliminating the element of unfamiliarity. The first experiment was tried at 9 A. M. After nine minutes of running about and climbing over the box, one of the rats suddenly seized the paper and tore it loose (one strip only was used). The noise of the door springing open frightened the rats

portant it is to conform to the character of the animal studied. This previous experience of one of the rats in this series possibly accounts for the apparent superiority of the rats used in this series over those used in Series II of this group.

Experiment 1. After the usual reconnoissance the rats pawed away the small amount of sawdust that chanced to be around the bottom of the box; then pulled off one of the strips of paper. The other strip, being attached loosely, permitted the door to swing inward about half an inch. The rats attempted to squeeze their heads in, and thus forced the door open. Time, 10 m.

Experiment 2. Got the door open in 14 m. They appeared to give up after working a few minutes, but soon returned with renewed vigor.

Experiment 3. The rats have located the obstacle, and confine their operations to the immediate vicinity of the metal door —pushing it with nose, *clawing* at the papers—not gnawing— and occasionally digging away the sawdust. Finally *clawed* the paper off. Time, 3 m.

Experiment 4. *Clawed* the paper off. Time, 2 m.

Experiment 5. They spent much time digging the sawdust away from the front of the door. They seem not to have learned

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away, but after a short hesitation they entered and secured the food. Time, 10 m. Experiment 2 was made 25 m. later. (The food was taken away—only a crumb being allowed as a "reward of merit.") After 20 m. of investigation the rats gave up the task and lay down in their nest. The box was removed. Experiment 3 was tried at 3.50 P. M. the same day. The spring was thrown after 45 m.; but this was accomplished by casually butting the head against the door. For 12 m. after the door was open their timidity prevented them from entering the box. They then snatched the food and ran out as if in great terror. On the following day four more experiments were made. The time was reduced to 3 m. in three experiments. The place was located, but the paper was not identified as the obstructing object. After experiments 4, 5 and 6, the food was taken away. In the 7th experiment the rat that had done all the work before seemed stolid and refused to work. The other rat accomplished nothing. The former died the same day. This apparatus was then given up, and Box I was tried.

These experiments were not a total failure, though the number was insufficient for the attainment of definite results. But their value would have been vitiated even if the rat had lived and they could have been carried further, for the method was very crudely applied. (a) The most opportune time for experimentation with rats is their time of greatest activity—late in the afternoon. They normally sleep all day. Their activity in the morning was purely factitious, due to extreme hunger. (b) The quick succession of experiments, followed in each case by deprivation of the fruits of their labor, was bad method. Nothing could be worse pedagogically, at least from a human standpoint. To establish an association train of which the motive and first term is hunger, and the end and last term is satisfaction of hunger, the train ought to be fully realized each time. The success of the later experiments, under the same conditions, established the validity of these corrections.

yet that the strips of paper are the real obstacles. They claw at the papers in a haphazard way—a sort of general scramble about the door. Nothing definite is yet expressed in their movements. Time, 3 m.

Experiment 6. Tore open the door, using both teeth and claws, in 1½ m.

Experiment 7. Tore open the door in 2 m. A few minutes later one of the rats went carefully sniffing around the outside of the box. She then entered and examined the inside, sniffing and pawing curiously. After coming out she dug the sawdust from under the edge of the box near the door. These actions illustrate the rat's method of getting thoroughly acquainted with his surroundings. The prominence of the olfactory and the motor elements are striking. The digging suggests that this box is not yet discriminated from Box I.

Experiment 8. The rats ran around and over the box a few times, and then dug a few strokes in front of the door. Then one of the rats, seizing one of the paper strips firmly in her jaws, tore away the upper half. Ran away as if frightened by her success. Soon returned and tore off the *other half.* She then seized the other piece and jerked that off. Entered immediately, got food, and came out to eat. It was a definite, business-like proceeding. Time, 3 m.

Experiment 9. Time, 1 m. Ran once around the box; then stopped in front of the door and dug away the sawdust. *Clawed* at the paper, using the teeth only as accessory. It is pretty clear that they use their teeth only as a last resort. N. B. They had not eaten last night's supper, yet they worked just as though they were hungry. This suggests at once the complexity of the problem we are dealing with. The action of the rats in this case is probably an outcrop of the primitive hoarding or property instinct. This is exceedingly strong in rats. An admirable illustration of the point is furnished by a female rat, with young, who made twenty-five journeys from and to her cage, carrying food;[1] and, in general, both male and female show a well-marked tendency to provide against a rainy day. Incidentally this is eloquent testimony to the persistence of "wild traits in tame animals,"[2] for these rats are practically strangers

[1] This was a rat whose litter of young was under observation. As she was quite tame her cage was often left open, so that she could roam over the table upon which stood several cages. On one occasion several small piles of dog-bread (small pieces) had been left about the table. Soon after coming out of the cage she discovered one of the piles, and proceeded to carry all of the bread to her cage. Then she continued her quest, and did not stop till she had secured every pile, making twenty-five journeys. This, in the face of the fact that she was always well-fed and had food in her cage at the time.

[2] *Cf.* Dr. Louis Robinson's book, Wild Traits in Tame Animals. London, 1897.

to hunger. The puzzling side of the matter comes into relief when we remember that oftentimes the rats, when not hungry, are quite indifferent to the presence of the box containing the food. These vacillations of conduct are explicable only upon the basis of radical fluctuations in the organic tone of the animal, something akin to the fluctuations in the human organism, as, *e. g.*, when the normal acquisitive impulse is inhibited by the feeling of indolent ease.

Experiment 10. One rat did all the work. The other entered immediately after the first one was out. The successful rat dug away the sawdust from before the door, and took hold of one of the papers which projected slightly below the bottom edge of the box. This act throws light upon the remarkable persistence of the useless digging movements. The projecting papers are brought into view by the digging away of the sawdust, and are bitten at quite naturally. The digging seems useful to the rat. The second piece she quickly tore off, seizing it firmly in her jaws about midway. Time, 30 sec.[1]

Experiment 11. Rat I ran once around the box, paused in front of the door and dug two strokes; then tore off the strips of paper in quick succession, seizing each strip firmly in the middle. No clawing or useless biting at the papers. The rapidly perfecting definiteness of this reaction is apparent by reference to the remark in experiment 9, apropos of the use of the teeth. Time, 30 sec.

Experiment 12. Rat II ran once around the box, dug away the sawdust from the door, and then poked the door open with her nose. Rat I remained in the nest. Three methods of opening the door have now been employed successfully: clawing, biting, and butting with the nose. Biting, as the most rapid and effective, seems to have been adopted finally by Rat I. Time, 30 sec.

Experiment 13. Rat I, after two strokes of digging, tore off the papers with her teeth. Time, 15 sec. In the course of these thirteen experiments Rat I has definitely located the obstruction (this was clear at the eleventh trial), and has eliminated all the useless preliminary movements except a mere vestige of digging. The time is reduced from 10 m. to 30 sec.

Experiment 16. Time, 20 sec. Rat I was evidently very hungry—so hungry as to fall into the error of digging violently. She stopped suddenly after a few seconds and made a savage attack on the papers. The action suggested that the hunger feeling was so strong as to start off automatically the digging reflex, which was inhibited suddenly by the memory

[1] It was at this point that these two rats were first marked, for the same reason as III and IV. They are designated I and II hereafter.

of the right action. The occasion of the resurgence of this memory may have been either the sight of the door and papers, or the rising of the impulse to bite the papers, this action having followed the digging each time in the process of getting the food. Under stress of hunger, attention was directed away from means to the end. Consequently, instead of a minimizing of useless movements, there was freedom accorded to the automatic movements.[1]

Series II. Rats III and IV. This series followed immediately Series II of Group I. The rats had had no experience with this apparatus. This series, therefore, is more typical of the rat's attitude toward this task (Box II) than is Series I. Reference to Table II will show this numerically.

Experiment 1. No results at the end of 30 m. The rats clearly recognized a different apparatus. They did not dig at the accustomed place, but ran around and over the box sniffing curiously. The movements were deliberate and seemed impelled as much by curiosity as by hunger. Occasionally they sniffed at the food which lay against the back side of the box—away from the door; and made one or two desultory strokes in the sawdust at that point, but showed little interest. They also nosed the papers a few times but made no attempt to bite or claw them or to butt the door. At no time did they dig in front of the door. The absence of this movement is striking, in view of its chronic persistence with Rats I and II. The box was removed at the end of half an hour. The rats were not fed.

The two interesting features of this experiment are the recognition of a different box and the non-persistence of the digging habit. One cannot but ask whether the digging impulse in this case is inhibited by the recognition of a different task—a recognition which was not at all apparent in the case of Rats I and II.

Experiment 2. Rats very hungry. At the end of 45 m. they had made no progress. Once or twice they sniffed at the door—the contrast between the solid metal of the door and the wire mesh of the rest of the box doubtless exciting attention—but showed clearly that they had no suspicion of its use. They dug all the sawdust away from the back corner where the food was, and spent most of the time savagely biting and pulling at the meshes. At the end of 45 m. the food was moved over near the door. The rats continued to bite stupidly at the wires. Box

[1] The next experiment gave striking confirmation of this view. Rat I was so hungry as to try to get at the box before I removed my hand. In her excitement she gave way to several of the useless preliminary movements that had been sloughed off. Time, 35 sec. In experiment 18 she appeared less excited, discarded nearly all the useless movements, and did the work in 10 sec. Similarly in experiment 19.

was removed at the end of one hour. It is possible that their extreme stupidity may have been due to hunger—they had had nothing but a little milk for 48 hours—as is suggested in the case of the recrudescence of useless movements in experiment 16 of Series I. Curiosity, which might lead them ordinarily to attack the papers, is choked by hunger, so that they blindly follow their noses, attacking the wires nearest the food. There was also a noticeable heightening of suggestibility, each rat feverishly doing what the other did—as if afraid the other would gain some advantage.

Experiments 3 and 4. In the third experiment the rats made no progress in 30 m. (No food had been given them except a little milk.) The box was left in the cage. During the night they removed one of the paper strips, but did not attack the other. The inference seems clear that the rats did not see the point. They would have gnawed papers from the broad side of the cage just as readily. The box was removed the next morning. A fourth trial was made in the afternoon—at the usual hour. At the end of 30 m. they had accomplished nothing and appeared to be utterly discouraged. I rubbed a drop of milk on one of the papers, thinking that it might suggest the appropriate action; but they merely lapped the milk off, and did not bite the paper at all. The box was again left in the cage. During the night they succeeded in solving the problem. They had gnawed the paper off neatly, leaving but a bit at the top of the door.

Throughout these four experiments, the persistence and the stupidity of the rats were equally surprising. Stupidity is not quite an exact term, for the rats in confining their efforts, as they did generally, to the vicinity of the food, were simply acting according to their usual habit of gnawing to food by the shortest way. The fact that they finally attacked the door implies that they came to have some kind of an idea of the box as a whole being the obstruction, for the food was somewhat removed from the door. The act would seem to involve a low order of judgment.

Experiment 5. Time, 3 m. Ran a few times around and over the box, but constantly came back to the door. It was apparent that the door suggested pleasant associations. Rat III then dug a little sawdust from before the door; ran away; returned and dug some more. She then paused, sniffed at the paper meditatively; suddenly bit one strip off very neatly. Startled by her success, she skipped away; but soon returned, sniffed the second strip, and quickly tore that off. She recoiled some inches at the springing of the door, but soon entered. This was the cleanest piece of work performed by any rat up to this time. The rat seemed to have the elements of the asso-

ciation chain well in mind. The co-ordination of the elements, however, was not immediate, as the hesitation at critical points shows. A stronger concentration of attention was shown here than was shown by Rats I and II at any time in Series I. The rapid integration of the association elements suggests either a higher degree of intelligence or a more powerful affective impression consequent upon the previous success after several days of failure and hunger.[1]

Experiment 7. Rat IV threw the spring by butting her nose against the door. Purely accidental; the papers adhering too loosely. The rat was surprised. Time, 1 m.

Experiment 8. The papers were cut in 4½ m. The rats seemed to know the obstruction but "put off" attacking it. The next experiment gave similar results. Time, 5 m. They walked leisurely around and over the box as if saying: "We can get in when we want to." The work was clean and sure when they got ready to do it.

Experiments 10–12. Experiment 10. The rats promptly attacked the task and quickly performed it. Rat III. No false movements. Time, 15 sec. Experiment 11 showed striking variations. Rat III went to work at once. She approached and sniffed at the door three times before touching the papers. Finally she poked the door with her nose; then braced her fore-paw against it and pulled the paper with her teeth. As it did not yield she ran away. Soon returned and got off one strip. Then she dug in a casual way at the corner near the bread. Finally came back and pulled off the other strip. Time, 1 m. She did not seem at all sure of her procedure. On the following day, she finished the task in 50 sec. Her movements were leisurely but as definite as could be desired; not a false movement was made.

The results of this group of experiments confirm those of the first group. (a) There is the same lack of initiative on the part of two of the rats. In both series of both groups one of the rats, by superior intelligence or activity, first solved the problem; afterwards these rats continued each day to open the door, the other rats complacently falling into the habit of entering the box, after the door had been opened, and getting the food, or of stealing the food from their successful companion. There was in the case of these inactive or unintelligent rats a manifest decrease of interest and effort in getting the box open between the first and the last experiment. On several occasions they did not leave the nest till their companions had opened the door. It is to be observed, also, that it was Rat III that did all the work in Series II of Group I. As Rats I and II were not marked

[1] The following day the time was reduced to 2 m.

in their series under Group I, one cannot be absolutely certain that Rat I did all the work; but the results of their series in Group II, and of the experiments with Rats III and IV in both groups leave little room for doubt. (b) The fluctuations in the time factor again come into prominence. Both series in this group exhibit these irregularities; but they appear more markedly in the second. In this series the required time falls from several hours to 1 minute, rises to 5 minutes, and falls again to 15 seconds within a period of 7 days. (c) The importance of the first success is also emphasized again in the second series of this group. This was evidenced not less by the definiteness of movement in the fifth experiment than by the decrease in time.

Some new points are brought out in this group. (a) The persistence of useless motor habits is striking. This was remarked in passing. The persistence of the digging habit was especially noticeable. This appeared prominently when the rats were unusually hungry or excited. Individual variations are apparent again in this respect; the tendency to dig is decidedly less marked in Series II than in Series I. The persistency of these motor habits is explainable by the supposition that the movements are touched off automatically: *e. g.*, the digging, by the sight of the box, the rat not yet discriminating the boxes. The action illustrates the thoroughly automatic character of motor memory. (b) The form the association takes seems largely fortuitous. The method the rat finally follows depends upon what action is accidentally successful the first time. If a rat happens to succeed by several methods, as, *e. g.*, biting, clawing, butting, there is a strongly marked tendency to select the most expeditious and effective method. This apparent selection, however, is rather a matter of inertia than of prevision. In general, it is safe to say the animal chances to hit upon the easiest method. (c) It can hardly be doubted that the affective tone of the animal organism conditions the associative processes. Slight variations in organic tone may throw the whole associative formation out of gear. This fact makes the estimation of the mental elements and values involved a difficult matter. Only proximate explanations are to be expected.

Group III. This group of experiments immediately followed Group II. The object was to test the rat's power of discrimination. The question arose, of course, in connection with Group II, in which a second apparatus, very like the first in appearance, was used. Both series seemed to indicate that the rats recognized a different apparatus, though the demonstration was clearer in the second than in the first series. In the first case the recognition of the new did not make sufficient impression to inhibit the almost automatic return to the old

method of entering the box by digging; but in the second series that method was not employed. But this experiment showed nothing of the real character of the discriminative process. In order to test more fully its character—its quickness and keenness, its permanence, and, if possible, its elementary character, this third group of experiments was made. Incidentally light is also thrown upon recognition and memory. In this third group the two boxes were used alternately, at unequal intervals, with the two pairs of rats. As the rats were now acquainted with both boxes, the quickness, certainty and appropriateness of reaction in the presence of each box would serve as a rough measure of the discrimination, allowance being made for fluctuations of interest under varying affective conditions. Twenty-five tests were made with each pair of rats, a summary of which follows. The order of alternation and the time results are given in Table III.

Series I. Rats I and II. This series was made immediately after a second trial with Box I.[1] They had not seen Box II for 12 days.

Experiment 1. Box II. Time, 1 m. Rat I was eager and hardly waited for the apparatus to be put into the cage. She sniffed at the door, climbed upon the box, came back to the door, dug a few strokes, poked the door with her nose in a tentative manner; finally she seized the papers (getting hold of both pieces) and tore them off. The actions were methodical and deliberate. The discrimination was not immediate, but seemed definite when arrived at. In the second experiment Rat I bit off one paper and then butted the door in with her nose. Time, 30 sec.

Experiment 3. Box I. Time, 1½ m. Rat I played around and over the box more than a minute. Finally, she went and smelled of the food which lay against the back side of the box; then came to the right spot and dug in. The action was perfectly definite *when she got ready to do it.*

Experiment 4. Box II. Time, 1⅓ m. Rat I spent half a minute climbing over the box. She then came to the door, pulled off one paper, and then tried to poke open the door with her nose. Failing in this, she dug all the sawdust away from the front of the box; then ran away; came back and pulled off the second paper. The movements in this experiment indicate that the rat is still in the "trial and error" stage. One would infer that she neither discriminates the boxes, nor knows what action is most efficacious after she has discovered

[1] These experiments gave no results other than imperfect recognition of Box I, after the series with Box II. The average time was longer than in Series I of Group I after the first.

which box she is dealing with. The contrast is marked between her recognition of Box I in experiment 3 and her confusion in this experiment. The repetition, too, of the procedure employed successfully in experiment 2 is worthy of note, especially as its failure in this case was followed by a lapse into complete incertitude as indicated by the digging. The three succeeding experiments with the same box gave practically the same result, confirming the judgment expressed above.

Experiment 7 (same box), shows some improvement. Time, 50 sec. Rat I dug completely under the box; then changed tactics and bit off the two strips of paper in rapid succession. Between the two acts there was a slight pause, the rat giving one the impression of thoughtfully considering and concluding: "I dig under and don't find the entrance; therefore, I'll bite these papers." If the reader will divest this process of its conceptual character and endow it only with the character of a conflict or succession of motor impulses conserved as memory and rising spontaneously at the sight of the box, he probably will not be far from right. The pause may be interpreted as the interval between the recognition of the failure of the first effort and the rising of the second and appropriate memory-image.

Experiment 8. Box I. Time, 30 sec. The movements were clean and rapid. It is not clear to me whether Rat I really *recognizes* this box or whether she digs automatically at the sight of any box, and so accidentally gives the appearance of recognizing. The facts noted in the preceding paragraph lend color to this interpretation. On the other hand, there seems to be more sureness and confidence in her attacks upon this box, a fact which looks toward actual recognition.

Experiments 9 to 14 inclusive were with Box II again. In the 9th and 10th the rats were either indisposed or not hungry. They were indifferent to the box, which was removed after 5 m. In experiment 11, Rat I ran slowly around and over the box, languidly dug the sawdust from before the door, and finally pulled off the papers by grasping them below the lower edge of the bottom of the box—a stupid and laborious performance. Time, 1 m. 10 sec. In experiment 13, after "fooling" for nearly a minute, Rat I did the work with expedition and certainty. Her actions suggested a small boy looking for an easy method of doing a thing.

Experiment 15. Box I. Time, 10 sec. Rat I. No false movements. Experiments 16 and 17 gave results similar in definitiveness and precision.

The final eight experiments, 18 to 25 inclusive, were made with Box II. These show the same fluctuations as noted in all preceding experiments, both in this group and other groups.

In experiment 18, Rat I, after "fooling" for nearly 40 sec., did the actual work in about 5 sec. In experiment 19, she succeeded in butting the door open with her nose. The next day she performed the task—biting off the papers—with few false movements, but it was by no means apparent that she realized that the paper was the obstructing factor. At the end of the series the matter was still in doubt, for in the last experiment, the door was butted open.

The fact most clearly demonstrated was that Rat II was utterly ignorant of the whole matter. She made no attempts in the latter part of the series to open the box, apparently quite content to share the benefits after Rat I had done the work, and doing nothing on those days when Rat I was out of humor.

The question raised under experiment 7 as to recognition of the boxes, by Rat I, receives a little light from the subsequent experiments. Absolute certainty is still lacking, but the rapidity, definiteness and precision of her movements in experiment 15, leave little doubt that she instantly recognized Box I. Her actions and manner had all the marks of the *feeling of security*, in contrast with the hesitation and indefiniteness manifested in the presence of Box II. This cannot be attributed to accidental correctness of automatic movements in the former case, for the appearance of security was observable from the moment she approached Box I; whereas her manner was doubtful and hesitating when she approached Box II. My conclusion is that she fully recognized Box I, but that the recognition of Box II was imperfect.

A similar conclusion is compelled in regard to the appropriate actions in each case. Rat I manifestly associated digging in a particular spot with the recognition of Box I. On the contrary, she never definitely associated biting the strips of paper with the appearance of Box II. In connection with biting, she continued to dig, as if supposing that work a necessary part of the process; and, throughout the series, never ceased to butt the door, though this method proved successful only three times, whereas biting was successful in thirteen cases in this series; in the series of experiments with this box under Group II, after the first five experiments, in which cases the door was sprung during a melee of scratching, biting and butting, thirteen cases of biting and only one of butting were recorded as successful. Indeed in the latter part of that series, the clawing and butting movements were almost entirely eliminated. The conclusion seems to be that under the uncertainty experienced in regard to Box II there was a recrudescence of the previously sloughed-off butting movement; and the series was not prolonged sufficiently to effect the re-elimination of this factor.

Series II. Rats III and IV. Followed Series II of Group II.

Experiment 1. Box I. Time, 1½ m. Rat III went at once to the right place, dug a little, in a doubtful manner, with one paw; then climbed upon the box. Rat IV went to the right place and sniffed, but did not dig. Rat III soon returned, dug tentatively till she could poke her nose under the bottom, and then dug with confident haste. The appearance of the rat before that was one of uncertainty and hesitancy. As soon as this clear space was found the recognition became complete. On the second day the movements were less doubtful.

Experiment 3. Box II. Time, 30 sec. Rat III worked quickly and accurately, with no hesitation, barring a little preliminary sniffing.

Experiment 4. Box I. Time, 50 sec. Rat III dug tentatively part way, then climbed upon the box. Returned and dug in. Lacked complete assurance. The following two days gave little difference in results, but in experiment 7 Rat III went instantly to the right spot and dug in confidently. Recognition was precise and immediate, and the appropriate movements were definitely associated.

Experiment 8. Box II. Time, 5 sec. The quickest and cleanest work I have seen. Rat III came around the corner of the box, sniffed the paper once, then seized and tore off both at once. (This, of course, was accidental.) The rapidity and precision of this action leaves no doubt that the box was recognized instantly. The integration of the association between the perception of the box and the appropriate movements was complete.

The six succeeding experiments were with Box I, and show striking uniformity, experiment 9 being performed in 25 sec.; the following 5 in 10 sec. each. Recognition and association here is perfect, no false movements being made.

Experiment 15. Box II. Time, 1½ m. At the end of ½ m. Rat I bit one strip partly off. The strip stuck, and she ran away as if not certain of her ground. After "fooling" a minute she finished the work. (No digging movements.) The rats seem bound to "fool." The next two days the work was quick and clean, 15 and 10 sec., respectively.

The last eight experiments in the following order of alternation: Box I, three experiments; Box II, one; Box I, one; Box II, three; showed that discrimination of the boxes was practically perfect. In experiment 23 Rat III was not hungry, for she gave up the task after making one or two feeble bites at the papers. She recognized the task clearly enough, but lacked the motive to push her efforts to conclusions. Rat IV made no effort to get in; and, indeed, she was a silent partner throughout, as was Rat II in Series I of this group. She merely

took her share of food after the task of securing it had been performed by her companion.

Comparison of this series with Series I brings out some rather striking facts, however. Rat I never perfectly recognized Box II, though she did recognize Box I. On the other hand Rat III, almost from the beginning, showed perfect recognition and discrimination of these boxes. As a correlative of this fact it was remarked that Rat I did not succeed in eliminating all useless movements in connection with Box II; and in selecting, for sole use, the patently most effective method of opening the box. Both of these things Rat III quickly did. This merely emphasizes the variability in the degree of intelligence in individuals of the same variety, a fact of importance in animal as well as in human psychology, which practically, if not theoretically, is too often overlooked. The evident differences in this case cannot be accounted for by fortuitous circumstances, by accidental variations in the manner of starting the associations. There is no external reason why the digging habit should have been retained by Rat I and dropped by Rat III, when dealing with Box II. Nor is the case any better with the persistence of the butting habit. References to my diary shows that Rat III, in the course of Series II, Group II, succeeded once in butting the door open, just as did Rat I in her series; and it shows also that during the latter part of their respective series in Group II both these rats nearly eliminated the butting movement. Its reappearance with Rat I in Group III clearly indicates confusion of images on her part; and this confusion marks her as inferior to Rat III in the power to form and retain a definite useful association and to discriminate two closely similar objects—two very essential factors in the complexus of intelligence.

Group IV. *Rats III and IV.* Complication of the problem with Box II. After Rat III had become perfectly familiar with Box II, as related in the description of Group III, the problem was varied and complicated by removing the spring from the door; so that when the papers were removed—bitten or clawed off—the door would remain in position instead of flying open. In order to get the food, the rat, after removing the papers, had to poke the door inward with her nose and crawl under far enough to reach the food. Several interesting and suggestive facts came out in the course of these experiments. These are noted in the following paragraphs. The actions of the rats in the first experiment of this group are best described by the notes taken at the time.

Rat III was apparently greatly surprised that the door did not open after she had removed the papers. She drew back and looked fixedly at the door; she then poked it gently with her nose, but was frightened by the swinging and did not try

to enter. She had pulled off the papers dexterously, dropping them whole in front of the door. These she now picked up and carried into a corner, according to the rat's prudent custom of turning them to account for nest-building. She then came back and poked the door again; then dug all about the front and sides of the box. So she went on for some five minutes, alternately poking the door, and running about and digging. Finally she plucked up courage to poke the door open and enter far enough to get a piece of bread. Rat IV now tried to steal the food, and for several minutes there was a struggle for the prize. The honest rat lost, of course; after which she went back boldly and got the second piece of bread.

There are three interesting observations in the preceding paragraph: the stopping to carry away the papers; the surprise and perplexity manifested when the expected did not happen; and the apparent feeling of the rat that she had done the right thing, as indicated by her constant returning to the door; her digging was only desultory, but her attacks upon the door were pointed and meaningful. All these points bear upon the question of associative formations.

It often happens that the bye-products of a process are hardly less valuable than the chief product. So in this experiment, the accidental manifestation of the working of the rat's mind is of considerable value in determining the *modus operandi* of the associative process. It is certainly significant that a hungry rat stops her quest of food in order to pick up and carry away to a corner some bits of paper. The meaning of this seems to be that the nest-building instinct is so strong, that the mere sight of a bit of available material serves to distract the unstable attention of the rat from her quest of food—hungry as she may be—and turns it to the other function. (I have noticed that the rats always gather up these papers, though they generally eat their suppers first. On several occasions, however, I have seen them carry away the pieces as they took them off, before getting the food; and once, I saw this done by a young female not yet pubescent. The males, too, have the nest-building instinct and do not fail to make a comfortable nest of any available material.) If one were to speculate upon the form of the associative process involved, it might be figured somewhat as follows: The sight of the paper excites the nest-building impulse (the nature of which is not analyzable; the motor element is undoubtedly large, though one could hardly speak of it as a motor image), with its proper affective coloring. This state acts as a starting point for a true motor-image—the impulse to seize and carry away the paper, which impulse or *thought* eventuates in the appropriate action. Whether or not this be a correct transcription of the procedure in the rat's mind,

the incident aptly illustrates the manner in which their associations are formed. Looked at in one way the associations are fortuitous, depending for their form upon external circumstances; but in another and more important sense they are more or less free, depending upon inner conditions. In any given case, the associative process is grafted upon some powerful organic tendency.

The further fact that the rat returned to the original problem immediately after disposing of the papers, suggests a question of some delicacy: How did her mind revert to that problem? The most obvious explanation would be that the sight of the box revived the interrupted association process. The suddenness and directness of the return, however, suggest that the reinstitution of that chain was due to central causes. The start was made before looking at the box. The most probable explanation seems to be the resurgence of the hunger feeling, and with it the half formed associative series, though there is no proof that some other elementary factor of the series was not the connecting link.

If we return now to the conduct of the rat towards the box, after her first surprise, we find another chance for interesting speculation upon the character and form of the associative process. The train already formed may be figured somewhat as follows: feeling of hunger, sight of box, smell of food (these two probably simultaneous), curiosity, location of food in box by smell (and sight), tearing off paper, getting food, pleasurable state. In some instances, as has been noted in considering the preceding groups, the first term of this hypothetical series drops out, and the mere sight of the box is sufficient to start off the train. (It is quite possible that the instinctive acquisitiveness furnishes the organic basis for the series in such cases. It is highly improbable that any excitation of a purely sensational character would furnish the motive force.) The connection of these links becomes so intimate that when the rat is normally hungry the appropriate movements are gone through with immediately upon seeing the box introduced into the cage. Now, when this associative process is broken up at the biting-off-paper point, as in this experiment, by the unexpected failure of the door to open, what happens in the rat's mind? The manifest purpose of the animal is to get inside the box, and this desire to get inside is coupled with the idea of getting in through the door. The modified form of the association train may now be: hunger, a mixed image, motor and visual, of entering the box through the door, getting the food, pleasure. That is, one of the terms of the chain is variable—the association is not determinate. When this term is expunged, another term, perhaps a suppressed one, rises to take

its place. Of course it is not necessary to postulate such a process as the following in the rat's mind: "Biting off paper fails of its usual result, therefore I'll try another method." The only necessary elements are: the persistence of the feeling of hunger, the location of the food inside the box, either as a present smell-sensation or as memory of getting the food inside the box, or both, and the memory of getting in at that place. This last accounts for the constant return to, and the poking of, the door. The rat is at first timid and suspicious of the door, but, as she is not hurt by it, her boldness increases; and this being further stimulated by the smell of the food, finally impels her to force open the door.

The pausing of the rat when the door unexpectedly failed to open might seem to imply reflection; but this is not so in any strict usage of the term reflection. Surprise and disappointment would be quite sufficient to restrain activity for the time; and these affections would preclude the possibility of reflection, unless reflection is used merely in a descriptive sense to designate the transition from this passive state to an active state under the resurging impulse of hunger. That the rat *feels* "why" or "what" is certain, that she thinks "why" or "what" is both doubtful and unnecessary.

If the preceding analysis is approximately correct, it is apparent that the primary determinant of this associative process is the feeling of hunger. But the process is not rigidly fixed. All the terms are variable, even the fundamental term of hunger, for it was shown that, after the problem had been solved, the rats when not hungry would perform the task under the impulse of the hoarding instinct. The carrying of the papers to a safe corner—completely breaking off the box-association—was in obedience to the command of the nest building instinct, the psychical motor accompaniment of the anticipatory maternal feeling.

The succeeding experiments of this group, like those of the preceding groups, showed the ability to profit quickly by experience. Fear of the swinging door gradually disappeared, but did not fade out entirely until the ninth day. Table IV gives the time results of the series. This table shows that fear of the door was not the sole factor in determining the quickness of performing the task. It was, however, the most constant factor, and largely conditioned the first ten experiments. As in all the other experiments the relative hunger of the rats and their instability of attention were influential. The increase in the required time in experiment 5 was due to a different cause. The position of the box relative to the cage was slightly changed, turned one quarter around. This change seemed to disconcert the rat; she went first to the usual place *relative to the cage*. Sev-

eral times she passed around to the door and smelled of the papers, returning each time to the old position, before finally biting off the papers. The sudden increase in time in experiment 11, presents quite a different case. Rat III got the bread as far as the door in 45 sec., but it stuck under the door. Thus baffled, she left the bread and went around the box as if to see what was the matter. She apparently tried once to push the door back with her paw while pulling at the bread with her teeth, but was unsuccessful. This movement was probably not an intentional attempt to push the door open. The explanation rather is that the rat was trying to brace herself and placed her foot against the door for that purpose. Careful observation on this point for several days showed no tendency on the part of the rat to push back the door with her paw, while pulling the bread from under the door with her mouth. In every case of success in getting the bread, the success was due to some accidentally favoring circumstance or to an unusually vigorous pull. The fact that this exceptionally bright rat did not hit upon this obvious mechanical relation, emphasizes the casual nature of the origin of most of the rat's associative processes. It is also clear, I think, that, what properly may be called ideas, find slight place in the associative process. Crass images—visual, olfactory, motor—organic conditions, and instinctive activities are assuredly the main elements. That these elements may bleach out and attenuate into ideas is not impossible. Analogy with human experience would indeed point to that conclusion.

The permanence of the association was demonstrated in the case of this rat by setting her to the problem again after a lapse of forty days. During this time she had not seen the box, but had been fed daily with dog-bread and milk placed freely in her cage. As she had given birth to and partly reared a family of young—her first litter—it would seem that her experience had been sufficiently varied and distracting to have obliterated the memory of the experience with the box. She showed, however, perfect recognition and discrimination, biting the papers off and pushing the door open within 25 seconds.

GROUP V. Character of the Associative Process and Individual Differences in Intelligence. In the preceding experiments two points had forced themselves upon my attention: (a) that the rats severally learned the task set them by doing it themselves; (b) that they manifested considerable individual variations in intelligence. It was to test further these observations that this group of experiments was made. Especially it was desired to note individual differences in intelligence; and, if possible, indicate some of the elements of difference. That differences of intelligence obtain among the lower animals as much

as in man, relative to the range and quality of psychic activity, is, *à priori*, to be expected. General observations, and the experiments already related, had demonstrated this in regard to the rat, but further examination of the matter was not undesirable.

For this group of experiments Box II was used. Four males, eight weeks old, brothers, designated *A*, *B*, *C and D* were the subjects. These rats were kept in a large wire cage, in which was a common squirrel revolver for exercise. They had been reared carefully, and were in perfect health and spirits. From birth they had been handled and petted, so that they were as perfectly fearless as rats ever become. To all external appearance they were as alike as so many peas.

The method was exactly as in other tests with Box II. At feeding time the box with the food inside was put into the cage. In all of the experiments the rats were minutely observed, and the relative ease and quickness, with which they severally built up the definite associative process involved in mastering the problem, were noted carefully. A special effort was made to detect traces of imitation. In a gross way the relative intelligence of the individual rats would be indicated, even if little or nothing were demonstrated as to the elementary character of the intelligence. The time factor is given in Table V. As in the other cases its significance is very general, both in regard to relative intelligence and to familiarity with the problem. It is suggested, however, that the time factor is much more regular in the latter respect with these *more highly domesticated* rats than with the others. They were subject much less to distraction of attention. The following extracts from my journal give the course and the points of main interest of the experiments.

Experiment 1. All four rats ran about in the usual way,—sniffing, digging, climbing over the box, etc. They also gnawed casually at the paper. At the end of three-quarters of an hour they had gnawed off one piece and bitten at the other, but they had made no concentrated effort. They were very "flighty"—running about the box, over their cage, and in and over the revolver.[1] Several times they all sat down in solemn conclave and washed themselves vigorously. At the end of 1¼ hours they succeeded in getting in. Rat *A* was the successful one. The rats are all suggestible—when one digs at any particular place, they all dig there. The same is true in a less degree in regard to clawing the paper.

Experiment 2. Rat A. Time, 1½ m. All ran around ex-

[1] These rats had been kept in this cage about three weeks, and had developed a great fondness for the revolver. They had made their nest in it, and always carried their food into it, whether they ate the food immediately or stored it against a time of need.

citedly for a moment, then *A* attacked the paper. He bit one piece in two, then carefully tore off both the upper and the lower half, as if under the impression that they still held the door. He then bit through the second piece. The work was done quickly, systematically and persistently, though the other rats got in his way and hindered him. They gave him no assistance, however. He knew what he wanted; they did not.

Experiment 3. Rat A. Time, 1 m. Very direct and business-like performance. The other rats crowded in his way, but he pushed them aside and took off the papers in quick succession. (Did not stop for the pieces this time.) He entered immediately, seized a piece of bread, came out, ran quickly and furtively around the cage, and hastily climbed into the revolver to enjoy in peace the fruit of his labors. One could not fail to note his manifest desire to conceal his "find."

Experiment 4. Rat A. Time, 25 sec. None of the other rats made a bite at the papers, though they swarmed in *A's* way and into the box as soon as he got it open. Three of the rats were in the box at once. They came out almost simultaneously, and hastily scrambled into the revolver with their prizes; the fourth one was late in getting into the box, but he came out and tore wildly around the cage—like the wicked when no man pursueth—seeking a place of concealment, though the other rats were busily engaged in the revolver. The absorbing intensity of the desire to "keep," blinding him to the complete absence of all enemies, is one of the striking evidences of persistence of "wild traits" that have been of fundamental importance to the life of his race. A few moments later *A* lost his piece of bread in the litter of the nest, and came back to the box again,—as if remembering his previous *modus operandi*. A nice question arises: whether a real memory image was the determining factor in this action, or whether the coming out was merely impulsive and the apparent purposiveness, due to the sudden sight of the box after leaving the revolver. The latter explanation commends itself as the simpler, but the rapidity and bee-line directness of the action suggests the former.

Experiment 5. Rat A. Time, 20 sec. *A* ran once around the box before biting off the papers. One of the other rats followed him closely all the time and entered the box almost simultaneously with him.

Experiment 6. Rat A. Time, 20 sec. None of the other rats made any attempt to bite the papers. Experiments 7, 8, and 9 were practically repetitions of 6.

A was removed at the end of experiment 9.

Experiment 10. Rat B. Time, 2½ m. There was a considerable interval between the removal of the first and second

papers. All the rats seemed to associate the door with the desired end.

Experiment 11. *Rat B.* Time, 1 m. *Experiment 12.* *Rat B.* Time, 20 sec.

Rat *B.* was removed at this point.

Experiment 13. *Rat C.* Time, 2½ m. Rat *C* paused several times at the door before making a trial. Finally he bit off one piece. This seemed to give him confidence and he quickly tore off the other piece. *D* made no attempt.

Experiment 14. *Rat C.* Time, 3½ m. *C* bit off one piece at the end of 1½ m. He seemed surprised that the door did not open. He nosed around and gnawed a little at the woodwork of the box, but made no serious attack upon the second paper until 2 m. later. He was distracted by hearing rats eating in an adjoining cage. *D* made no attempt to bite the paper, though he was close beside *C* when he pulled off the first paper —their noses were almost touching.

Experiment 15. *Rat C.* Time, 2 m. The rat made three determined bites at the papers before getting one off. He ran all around and over the box after each trial. *D* followed closely. After *C* had pulled one piece half off, *D* caught the suggestion and pulled at the hanging paper. Then they played with the piece they had removed for about a minute, chasing each other like kittens. Imitation?

Experiment 16. *Rat C.* Time, 1¾ m. *C* removed the first paper in ½ m.; then played a minute before removing the other one. The rats were not hungry, for they had several small bits of bread stored away in the revolver. Their performance of the task without the incitement of hunger can hardly be accounted for except upon the basis of a hoarding instinct almost as imperative as hunger.

No further tests were made with *C* and *D*.

Rats *A* and *B* were tested again after the lapse of five days. Memory was perfect. Both rats attacked the papers, *B* getting off his piece first; *A*, the other piece immediately after. Twenty-seven days later this test of memory was repeated under circumstances so different as to warrant the expectation that there would be some hesitation; on the contrary the rat—it happened to be *A*—instantly attacked and tore off the papers—so definite and permanent was the association.[1] Time, 10 sec.

The results of these experiments in general served to confirm the observations and conclusions previously made in regard to the origin and the nature of the associative processes. The permanence of the association was confirmed and the impor-

[1]The conditions will be given in detail in connection with another experiment to be described in a later paper.

tance of the motor element in the memory was emphasized. There were several suggestions of imitation. These will be estimated in connection with the following group which deals particularly with imitation.

These experiments confirmed also the observations upon individual differences in intelligence. It is certain that some rats show more initiative and learn the tasks more quickly and easily than others. If we eliminate the elements of accidental first success and of distractions, the fact is not impaired. Interpreted more rigorously all the tables point that way. If we take the term intelligence in its obvious biological significance as the adaptive function of the organism by virtue of which definite useful associations (habits) are formed, then the demonstration of differences is clear. Upon what particular element of the intelligence-complex the particular variations depend can only be guessed at. There are, however, some noticeable facts in the results. (a) The most striking fact observed was the apparent superiority of these young rats over the adults used in the other experiments. Comparison of Table V with Tables II and III shows the superiority of these young rats over all the adults that were tested. Rat IV, *e. g.*, had experience of this apparatus for weeks in company with Rats III and II respectively, but did not learn the task in all that time; and Rat III, the brightest of the adults tested, presents a poor record in comparison with that of Rat *A*. (*A* reduced the time to 1 m. in experiment 3, and thereafter did the work in 30 sec. or less; while Rat III reached the 1 m. mark only in experiment 7, and varied thereafter for several days from 15 sec. to 4½ m. It is to be observed, also, that *A* succeeded in the first trial; III did not succeed until the fourth.) A detailed comparison would show a similar superiority of these young rats throughout. (b) A second fact of interest is that these rats were males. I am not prepared to contend that the male rats are more intelligent than the females, but this points that way. The young females used in connection with Group VI (*q. v.*) showed no more intelligence than the adults, while the adult male used in Group VI displayed more initiative than female IV. The comparison is not conclusive, however, for the young females in question were younger than the young males. The explanation may be in the greater activity and vitality of the males whereby their chances of hitting upon the right action are increased, while at the same time they are endowed with greater initiative. Superior vitality and activity doubtless is also one of the advantages of youth. (c) Another point worthy of notice is that these rats had become about as tame as possible. I am inclined to think that their almost complete freedom from fear was a very important factor in their superior intelligence.

The other rats were all more or less wild when I received them. The modification in character of these four was somewhat striking. It is not improbable that some information in regard to psychic variations may be had from studies of successive generations of animals under varying controlled conditions. The advantage of such studies is obvious, both for individual and genetic psychology.

The differences between particular individuals exist only within very narrow limits. They are almost solely in regard to the quickness and ease with which the associations are integrated and retained. Rat I, for instance, was inferior to Rat III in both respects, and, as pointed out before, Rat *A* was markedly superior to Rat III. The differences between the four young males were slight, but appreciable. No variation in method of performing the task appeared among them, though slight variations were noted among some of the adult rats.

In the way of explanation of the differences nothing more can be said than that they depend upon a complex body of interacting traits,—functional, muscular, perceptional, affective and other—correlated with corresponding physical characters. In a word it is a matter of organization. The means for analyzing further the difference between any two given cases are not at hand. As between *A* and *C*, for instance, it is impossible to say whether the difference lies in the neuro-muscular system, or in the organ of association, or elsewhere. It can only be shown that appreciable and definable differences do exist.

GROUP VI. Imitation. In this group an attempt was made to throw further light upon the matter of imitation. Many of the preceding experiments gave no evidence of imitation of any kind, others indicated a low form, about equal to motor suggestion, and in the last group there were some cases that seemed to imply a higher form. Being convinced that Rats II and IV had not profited by their companionship with the successful Rats I and III, I removed them from their respective cages and placed them together in another cage. They were tested then with Box II. The belief that they had not solved the problem, either by doing it themselves or by seeing it done, was confirmed. In spite of the fact that they had seen their successful companions perform the task not less than twenty times, they showed no acquaintance with the proper procedure. Table VI gives the numerical results. The conditions were exactly as in the preceding experiments. In experiment 1 of this group, Box II, containing food, was placed in their cage 24 hours after their last meal. The rats ran around and over the box, pawing, digging, sniffing, and occasionally biting at the wire mesh of the sides; but they showed no sign of recognition of the proper means of entrance, no more than if they had never seen the box before. At the

end of half an hour I removed the box without feeding the rats. The experiment was repeated at the same time the following day, with the result that Rat II got into the box in 2 m. She accomplished this not by biting or clawing the paper, but by butting the door with her nose (the papers adhered rather weakly). The movements of both rats were vigorous in proportion to their hunger. They wasted no time. They seemed, moreover, to locate the door as the point of attack, but without any definite method in their movements against it. The butting appeared to be accidental. In the third experiment the papers were fastened securely. Both rats clawed, bit and butted. I was unable to see which one was successful, but the fact that it was Rat II the day before and the succeeding days, leaves little doubt on the point. The association did not become *solid* in her case until the seventh day. Before that time her movements were somewhat aimless—running around and over the box and digging away the sawdust. The movements on the seventh, eighth and ninth days were so definite as to leave no doubt that she recognized the situation immediately. The marked increase in time of the three succeeding days was due to other causes than unfamiliarity—accidental distractions and variation in degree of hunger.

There was, in this case, an interesting variation of the *modus operandi* in getting the door open. Apparently the successful "butting" of the second day made a lasting impression, for the rat persisted in this mode of attack, resorting to biting only as a secondary means; and several times she succeeded in butting the door open after biting off the first paper.

As in all the preceding experiments, the inveterate "fooling" tendency was manifest. Rat II frequently would run several times around the box, pausing each time at the door, before making a real attack. This indecision appeared at times to be mere playfulness; at other times the rat seemed to be looking for an easier method of entrance, for she performed the task definitely enough when she got ready. Another possibility is that it was merely stupidity, the proper action not being suggested at first. The association was inhibited in some way. Whatever may be the explanation, this characteristic renders impossible the representation of the gradual perfection of the associative process by a uniform time curve, and complicates the analysis of the process.

After Experiment 12, Rat II was removed and a fresh rat, a male, *Z*, was put with Rat IV. They manifested equal ignorance of the process of getting into the box, the new one actually making the first purposive attack upon the door. He succeeded in pushing it open, the paper adhering loosely. On the second day, the door was more carefully secured. Neither

had succeeded at the end of ten minutes, so the box was removed.

After Rat IV was separated from Rat III, a half grown female was put with Rat III. The use of Box II was continued. The results of these experiments also weigh against imitation as an agency in the process of learning the task. In nine trials, this rat gave no evidence of imitating Rat III in getting into the box. Five experiments with another rat of the same age gave similar results. In the latter case the young rat learned the task quickly, but this was due to the fact that she happened to be hungry and eager two or three days when Rat III was inactive.

My conclusion from all this experimental work, and from much other observation of rats is that they do imitate, but that imitation with them is relatively simple. They imitate simple actions; but I have seen no case of what may, in lack of a better term, be called inferential imitation. By this I mean merely: learning to do a thing by seeing another do it—the purposive association of another's action with a desired end. For example, not one of the eight rats that might have learned to open the door of Box II by seeing another rat do it, ever thus profited by such experience. Each rat learned the task for himself, and learned it by doing it. On the other hand imitation of simple actions is of frequent occurrence. Very often if one rat begins digging, all are eager to dig in the same place; if one runs over the box, over the box they all go. This kind of imitation is exhibited in some simple experiments with the common squirrel revolver previously mentioned.[1] This was kept in a large cage containing several rats. In numerous tests by this method it was observed that almost invariably when one rat climbed into the cylinder others would follow. Such is also the form of imitation noted in the diary of the young white rats, where the young one imitated the action of the mother in pulling at a piece of excelsior.[2] This simple form of imitation depending upon the immediate functional connection between sensory and motor centers in a lower level—like the frown of a three months' baby when the nurse frowns—covers all the cases of imitative action I have observed in the course of these experiments. The fact that Rat *B* took so much less time than Rat *A* in learning to open Box II might be interpreted as evidence

[1] *Cf. Amer. Jour. Psy.*, Vol. X, No. 3, p. 425. "After the rats have learned to run the revolver a test of imitation may be made by introducing uninitiated rats into the cage. The difference in the time required to learn the lesson may be taken as a rough measure of imitation."

[2] Small: Notes on the Psychic Development of the Young White Rat, *Amer. Jour. Psy.*, Vol. XI, No. 1, pp. 87, 100.

that *B* had profited by *A's* experience, and, consequently, as evidence of the higher imitation. The assumption is unnecessary. *B* had profited by *A's* experience to the extent of associating the getting-into-the-box with the locality of the door, thereby eliminating the many useless movements around and over the box that a perfectly "green" rat would have made. The recognition of the door as the point of attack is probably due to his having entered there rather than to his having seen *A* strip off the papers.

Logically, however, this lower form of imitation might explain a more difficult case than the preceding. Suppose that one rat is led by immediate suggestion to imitate the simple action of another in gnawing the paper: *i. e.*, while one is at work, the other comes along and without any idea of the end begins to gnaw also—just as the young one referred to pulled the excelsior. The paper gives way and they both go in. The association is now started between gnawing at this particular place and getting the food, and may be perfected later. The imitative factor consists solely in the impulsive imitation of a simple action.

Wide as are the explanatory possibilities of this lower form of imitation, it is difficult to demonstrate that higher forms do not exist. In dealing experimentally with this matter there is one highly important factor that cannot be controlled completely, *i. e.*, attention. Distractions may be minimized almost to the vanishing point, but that point cannot be reached with such a psychically unstable compound as the rat mind. Even if external distraction were entirely eliminated, there would still be the insuperable obstacle of subjective conditions. And the conditions are distinctly unfavorable for demonstrating the higher imitation. The attention of the rat is focussed, under the compelling feeling of hunger, upon getting at the food. The call is for individual action. Attention is turned away from the actions of his companion. It is not impossible that a form of imitation, involving the higher associative processes, might be demonstrated if it were possible to direct the attention of the rat to the actions of the other rat, while retaining undiminished the affective basis for action. Any attempt, however, to restrain or constrain the animal would defeat the desired end—attention would assuredly be diverted from the objective point to the restraining conditions—would be lost in the affective absorption induced by them. An illustrative case is an experiment recorded by Dr. Thorndike[1] in his experiments with cats. In this case the experimenter tried to instruct his cats to perform certain acts by holding the paw and guiding its

[1] Animal Intelligence (*Psychological Review*, Monograph Supplement, No. 8, June, 1898), page 70.

movements successfully. "I took the right paw and, putting it against the lower or right-hand side of the button, pressed it round to a horizontal position." Three cats were tried, but none learned to do the act this way, although the lesson was repeated several times. This method manifestly disregards the factor of attention above adverted to, and consequently fails to demonstrate the absence in animals of those higher associative processes involved in inferential imitation.

The matter is still open, though my own observations upon the rat predispose me to regard the explanation in lower terms as probably correct in the case of that animal. It would seem that the rat is probably incapable of attending in such a way as to bring the relation of perceived means and end into focus; and consequently incapable of higher imitation.

It cannot be assumed, however, that this presumptive conclusion, even if it were more certain, can be stretched to include the imitative processes of all other animals below the primates. (There is hardly any doubt in regard to the primates.) The mental divergences among species, and even among varieties, are so great as to preclude any crass generalizing. However strong one may feel the *à priori* assumption to be, definite conclusions must wait upon more abundant concrete evidence and the fuller returns of comparative neurology.

TABLE I.

Exp.	Series 1. Time.[1]	Series 2. Time.
1	90 —	35 —
2	8 —	2:30
3	2:30	2 —
4	3	1 —
5	3:30	1:30
6	2:30	— 30
7	1 —	1.30
8	5 —	— 30
9	1:30	——
10	1:45	— 10
11	1:30	— 15
12	— 30	— 10
13	— 45	— 10
14		— 18
15		— 15
16		— 30
17		— 40
18		——
19		— 20

TABLE II.

Exp.	Series 1. Time.[1]	Series 2. Time.
1	10 —	Failure.
2	14 —	"
3	3 —	"
4	2 —	Indefinite.
5	3 —	3 —
6	1:30	2 —
7	1:30	1 —
8	3 —	4:30
9	1 —	5 —
10	— 30	— 15
11	— 30	1 —
12	— 30	— 50
13	— 15	
14	— 35	
15	— 10	
16	— 20	
17	— 35	
18	— 10	
19	— 20	

TABLE III.

Exp.	Series 1. Box.	Series 1. Time.[1]	Series 2. Box.	Series 2. Time.
1	II	1 —	I	1:30
2	II	— 30	I	— 30
3	I	1:30	II	— 30
4	II	1:20	I	— 50
5	II	— 50	I	1 —
6	II	——	I	1:30
7	II	— 50	I	— 25
8	I	— 30	II	— 05
9	II	——	I	— 25
10	II	——	I	— 10
11	II	1:10	I	— 10
12	II	— 30	I	— 10
13	II	1 —	I	— 10
14	II	— 30	I	— 10
15	I	— 10	II	1:30
16	I	— 20	II	— 15
17	I	— 20	II	— 10
18	II	— 45	I	— 15
19	II	— 25	I	— 10
20	II	— 25	I	— 10
21	II	1 —	II	— 15
22	II	——	I	— 15
23	II	— 35	II	——
24	II	——	II	— 30
25	II	1 —	II	— 30

[1] The time is in minutes and seconds in all the tables. The long dash in the time column indicates that the box was removed after 5–10 minutes.

TABLE IV.

Exp.	Time.
1	5:30
2	3 —
3	3 —
4	2:30
5	5 —
6	——
7	3 —
8	1 —
9	— 50
10	— 10
11	2 —
12	— 20
13	——
14	— 20
15	——
16	— 55

TABLE V.

Exp.	Rat.	Time.
1	A	75 —
2	A	1:30
3	A	1 —
4	A	— 25
5	A	— 20
6	A	— 20
7	A	— 20
8	A	— 30
9	A	— 30
10	B	2:30
11	B	1 —
12	B	— 20
13	C	2:30
14	C	3:30
15	C	2 —
16	C	1:45
17	A&B	— 10

TABLE VI.

Exp.	Rat.	Time.
1		——[1]
2	II	2 —
3	II	3 —
4	II	3 —
5	II	3 —
6	II	2 —
7	II	— 30
8	II	— 30
9	II	— 20
10	II	1:15
11	II	— 50
12	II	1 —[2]
13	Z	1 —
14	—	——
15	IV	5:30
16	Z	2:30

[1] Removed at end of ½ h.; neither got in. [2] Interval of 4 d. between 11 and 12.

PSYCHICAL LIFE IN PROTOZOA.[1]

By G. P. Watkins, A. B.

Any one of the higher animals, it is commonly held by modern physiologists, is a colony of unicellular organisms. Hence the cell in its free and undifferentiated state should possess, in some elementary way, all the properties which are later highly developed through specialization in the metazoon. The following words of Verworn are perhaps representative of the present attitude of physiologists: "Elementary life phenomena are inherent in every cell, whether it be a cell from the tissues of higher animals, or from the tissues of lower animals, whether it be a cell of a plant, or, lastly, a free cell, an independent unicellular organism."[2] Among these properties of the original free cell must have been something corresponding to mentality, Mind has not been superadded in the course of animal evolution. As Cope says: "The conscious cell is the primitive cell, and the unconscious cell is the modified or specialized cell."[3] The cells of the brain have been perfected with reference to psychical attributes, but, again in the words of Cope, they are "the least modified of all those that constitute the soma of the metazoon, and thus they resemble most nearly the simple beings which constitute the lowest forms of the Protozoa."[4]

From all this it should follow that a specialized nervous system or a high organization is *not* a precondition to mentality' but that mentality in some sense is a property of the original cell.

If the above theory be accepted, we have, in the evolution of the higher organisms, a compounding of minds. The human being is a colony psychologically as well as biologically. There are specialization and interdependence of diverse elements, and the unity is not the unity of a simple thing, but that of a system. Thought is an aggregate function.

Prof. James, however, objects that mental states cannot be compounded and cannot be composite. But this is only one aspect of a very general difficulty for him. For he says: "Atoms

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[1] From the Psychological Seminary of Cornell University.

[2] *Monist*, art. "Modern Physiology," Vol. IV, p. 371.

[3] *American Naturalist*, art. "Evolution of Mind," Vol. XXIV, p. 903.

[4] *Ibid.*, 903.

of feeling cannot compose higher feelings *any more than atoms of matter can compose physical things*" (italics mine); and, also: "The thing we name has no existence out of our minds."[1] Thus is involved the question as to what is the nature of a compound in general. And it must be admitted that, from a philosophical point of view, though mental states have the form of time, and some of them that of space, one can know directly only a single mental state in isolation. In going beyond the mental state as such, there is a sort of inference. If several mental states connected in experience are jointly referred to various *attributes* of a particular *thing*, it is an inference. If, under certain conditions, some of these *things* disappear more or less completely, and we have in their place another *thing* with attributes more or less different, this we name a *compound*. This compound, it must be admitted, is such only with reference to its effects on us. But is anything else, so far as we know it, what it is, except with reference to its effects on us? As to what occurs apart from us, we can only infer, can only symbolize. But symbolize we must. It is our nature to construct a world-order by such inference. And among notions found of use in this process is that of a compound,—a something which, under certain circumstances, takes the place of, or results from the union of, several other things. We need not be able to recognize the elements in the compound; we never do in chemistry. We need not be able to picture to ourselves under the forms of space and time the mechanism of the process of compounding. We do not usually, and ought never to think of a compound as the mere sum of its elements,—and this is the mistaken position against which Prof. James' argument is really directed. We recognize that a compound is itself and not something else. The sum of the matter is that the elements have been lost in the compound; in which they may seem to leave no traces.

A compound in this sense is just as conceivable, applied to mental states, as it is for chemical elements. There is no "assumption that our mental states are composite in *structure*, made up of smaller states conjoined" (italics mine), as Prof. James says there is.[2] "Resemblance," it is admitted, "cannot always be held to involve partial identity."[3] But partial identity with elements is no essential feature of a compound; and, furthermore, the statement is too weak, "cannot always" implying "can sometimes." "If one feeling feels like no one of the thousand" of which it is composed, it nevertheless can "be said to be the thousand"[4] in the same sense that water

[1] *Principles of Psychology*, Vol. I, p. 161.
[2] *Op. cit.*, I, 145.
[3] *Ibid.*, 158, ftn.
[4] *Ibid.*, 163.

may be said to be composed of hydrogen and oxygen. According to the usage of language a thing *is* its elements related or conditioned in a particular specified way, or *is composed* of such and such elements, simply enumerated. Nobody maintains that a compound is its elements under no matter what conditions; but only that it contains them. If the "mind-stuffists and associationists" say "that if the states be posited severally [under certain conditions, let us add] their collective consciousness is *eo ipso* given; and that we need no farther explanation or 'evidence of the fact,'"[1] they are doing no more than the chemists who say that, given free hydrogen and oxygen gas under certain conditions of position and the advent of something hot enough, and you have water. It is wholly a question of factual connection in experience, beyond which we cannot go. Nobody says unqualifiedly that the series of states is the awareness of itself,[2] but rather that the series under certain circumstances carries with it awareness of itself. The latter may be "evolved"[3] out of the former in the same sense that anything is evolved out of other things. Composition is not the mere summation or mixing or juxtaposition which Prof. James, with resulting irrelevancy, assumes it is.

Let it be admitted that compounding consists only in a merging or losing of one set of effects to form a new set, and that an aggregate unity exists for the subject only.[4] All the identity we can allege is the inferential identity of substance or support,—something beyond our experience. But mental states can be compounded in the same sense that any other things can be, and the concept of psychical as well as of physical compounds is found to be useful. Whether the "soul" is that upon which these effects combine is another question. Prof. James does not quite dare to go so far as to maintain that the "unitary" character of mind demands that all impressions be concentrated at a single point or a single cell of the brain, yet his leaning towards a theory of a central or "pontifical cell"[5] strongly reminds one of Descartes. But nothing is explained by going to the substance behind mental states, whether the name given be soul or something less objectionable. Science has no use for such an hypothesis. We do not even know what "unity" means, as predicated of this substance. Hence we can accept compounding as a phenomenal fact in the one sphere as well as in the other.

To be taken in connection with the position of Prof. James

[1] *Ibid.*, 162.
[2] *Cf. ibid.*, 162.
[3] *Cf. ibid.*, 160.
[4] Royce in James, *op. cit.*, I, 159.
[5] *Ibid.*, 179–81.

just touched upon is his attitude towards the relation between the mental and the physical. He thinks it "the ultimate of ultimate problems . . . . why and how such disparate things [as thought and brain] are connected at all."[1] This "why and how" means for Prof. James, I suppose, as for many, reducing the connection of thought and brain to figuration in the spatial mode of perception. The difficulty is that we cannot picture in this way a mental state, nor can we thus represent its connection with a thing that we can picture, *i. e.*, an extended object. The relation cannot be thought of mechanically, in terms of space. But the factual connection remains the same, and it is with this that we are concerned. Color and form are "disparate," but they are both perceived in the space mode. Is this the essential thing rather than the fact of connection?

There are difficulties, too, in any other than the "mind-stuff" or composite interpretation. It is quite possible to accede to the implication of Prof. James' challenge, "If evolution is to work smoothly, consciousness must have been present at the very origin of things."[2] It is perhaps better, however, from a methodological point of view, for us, as psychologists, to contemplate the possibility of carrying back mind only so far as we find life. Here the principle of continuity may help us; but the question is one of the interpretation of evidence. Prof. James, however, is not so good an evolutionist.

What, for instance, are we to do with secondary reflexes? Prof. James says: "Either lack of memory or split off cortical consciousness will certainly account for all of the facts."[3] This is, indeed, taking liberties with memory. It is just when one is intently occupied with some train of thought that one is most likely to respond to stimulus reflexly; and at this time anything crossing consciousness to interrupt this train (for "we cannot have two feelings in the mind at once")[4] would be especially likely to be remembered. As for the "split-off cortical consciousness," it is quite in accord with the theory that James opposes, but may an individual have several *unitary* "souls" or minds? So, it seems, the real difficulty of pointing out where this "disparate" element, consciousness, enters in, both in the development of the individual and in the animal series,[5] is far greater than any imagined metaphysical

[1] *Ibid.*, 177. [2] *Ibid.*, 149. [3] *Ibid.*, 165. [4] *Ibid.*, 157.

[5] Pres. Jordan has an article on the "Evolution of Mind," in Appleton's Pop. Sci. Mon. for Feb., 1898, also reprinted in "Footnotes to Evolution." The article has great *popular* value because of its attitude towards continuity, but it is quite inadequate psychologically, as it assumes, without hint of possible difficulty, that consciousness evolves from reflexes.

difficulty about the intelligibility and conceivability of compounds, both physical and psychical. Acquired reflexes show that there is no chasm between conscious and unconscious action.

Continuity, too, unless the survival value of consciousness is done away with, is necessary for the explanation of instincts. One view would make complex reflexes and instinctive actions mental degenerates. Another would evolve mind from reflexes. But where is the limit to such mechanical or reflex and instinctive adaptation? When would the uncertainty introduced with consciousness be an advantage to the organism? Logically, the second view makes consciousness an epiphenomenon, man an automaton, and his mind no part of the mechanism. Furthermore, on the supposition of "disparateness" in reality as well as in fact, consciousness could hardly be other than an epiphenomenon correlated with a certain complexity of nervous organization. But the relation is not satisfactory. Why should there be such a correlation? And where would be the line between conscious beings and the unconscious? Our knowledge of reflexes, inherited and acquired, does not lessen the difficulty. These facts point to some theory according to which consciousness would be correlated with hesitation, indecisiveness, and imperfection in the ordering of reaction, rather than with complexity. It is difficult to see how such an incipient consciousness at the stage of complicated reflexes could be other than disastrous. Adaptation of species could, *ex hypothesi*, be perfectly kept up by mechanico-organic variations. Incipient consciousness in the individual organism would be disadvantageous because of loss in rapidity and accuracy of reaction. The little adaptability to change in environment would probably be not sufficient to outweigh this disadvantage, and even that little would be but a duplication of means to an end already attained by purely physical or organic variation in the species. And, since the physical can do this adapting, if it can do so much besides in the way of complex reaction, why should there be any mental at all? What opportunity is there for it even to come on the field?

A primitive consciousness, on the other hand, may have been of survival value. It would have had to compete only with the simplest, even merely chemical, forms of reaction. Its incipient complication of modes of action would probably be of high adaptive value. It is not impossible that the great function of consciousness in the animal world is the building up of complex modes of reaction. The fixity of the reflex is perhaps a later stage in which mind is largely relieved of the care of completed modes of reaction. In the development of species consciousness may thus in some cases have even been quite lost by adapta-

tion. With consciousness accompanying life at the start, indefinite variation in the mental as well as in other matters organic should be expected, so that mind would be moulded by its environment into forms of survival value. Not only could conscious adaptation, through the inherited effects of habit, aid in the formation of instincts and reflexes, but it has perhaps also done more than we suspect in developing the potentialities of organized matter.

Although it has not been necessary, for present purposes, to distinguish between two separable problems involved in this discussion, it may be well here to touch upon the bearings of a possible distinction. Prof. James attacks indiscriminately "mind-stuffists and associationists." But the problem of the compounding of minds is different from that of the compounding of sensations, and the difference is not wholly that between the subjective and the objective points of view, since the minds compounded would scarcely be thought of as becoming each a particular sensation in the resulting mind. What seems to be the best attitude toward the problem of the compounding of sensations has already been indicated. As for the compounding of *minds*, it seems to the writer that the question is one of fact, and that the answer is implicitly taken for granted by modern psychology. No one finds a difficulty, either in the addition of "minds" or in the fact of co-operation, when, in the course of evolution, more cells than before come to perform the mental function. Nobody maintains that less than a plurality of cells function during, and by necessity coincidentally with, the consciousness of an individual.[1] The doctrine of psychophysical parallelism itself involves a multiplicity of cells functioning in unison, with activity not in a single point, but in an area of the cortex necessary for the conscious accompaniment. If it be still objected that we cannot *see how* this compounding of minds could take place, the difficulty is probably due only to what is in some sense an *idolon tribus*, our habitual mechanical mode of thinking.

Thus, it is hoped, have been removed any *à priori* difficulties in the way of admitting consciousness in the organic world wherever the facts seem best explained by supposing it present. There is no reason why we should admit consciousness only at the latest possible stage of evolution. We have to admit it as a *vera causa* somewhere. We should be ready, then, to admit it, always guarding against anthropomorphism, at whatever degree of complexity the evidence warrants. And we should also use it, with due regard for continuity, in a way to give the best

[1] But *cf.* the leaning in James' "pontifical cell," pp. 179-81.

theory of organic life as a whole, both physiological and psychological.

M. Binet has collected an interesting body of facts bearing on the habits of some micro-organisms, which, he seems to believe, have "psychical life." Yet in one place he says: "We are not in a position to determine whether these various acts are accompanied by consciousness, or whether they follow as simple physiological processes."[1] Furthermore, he does not discuss the interpretation of these facts, though, since most of the facts themselves seem to be accepted, this is really the critical point.

Have protozoa psychical life? This again involves the question: What is the objective criterion of mentality? And the answer to this must have reference to the essential nature of mind,—a question not to be settled by characterizing mind as having "consciousness," for this term means hardly more than mind in the concrete, perhaps with an implication of *self*-consciousness.

In predicating mind of some other being than myself, I am inferring the existence of something of which I can have no experience. My direct knowledge is limited to my own consciousness. Inferring the presence of mind in others, I proceed by analogy and by comparison with my own acts objectively considered. Resemblance to me in respect of possessing consciousness is inferred (so far as I arrive at the conviction rationally) from resemblance in other respects. Therefore the cogency of evidence diminishes as I recede from minds like my own.[2] Yet there must always be some quality in common with my own mind,—the quality, too, if the word 'mind' as thus used is to be susceptible of definition at all, upon which that definition depends.

On the criterion of mentality, Romanes' position is perhaps the most important, and as nearly typical of current views as any. He says: "Ejectively considered, the distinctive element of mind is consciousness, the test of consciousness is the presence of choice, and the evidence of choice is the antecedent uncertainty between two or more alternatives."[3] Still he thinks that complexity and unpredictability are not enough, but that we must know the non-mechanical character of the act or the mentality of the agency,[4]—which position is not very satisfactory, since these are just the things we should be uncertain about. Again, he says, "it does not follow that all adjustive

[1] *Psychic Life of Micro-Organisms* (trans.), Chicago, 1897, p. 61.
[2] So Romanes, *Mental Evolution in Animals*, p. 22.
[3] *Mental Evolution in Animals*, p. 18.
[4] *Ibid.*, 19.

action in which mind is concerned should be of an antecedently uncertain character;" but by independent evidence [independent of any particular case of antecedent uncertainty, presumably] we may know that the agent is mental,[1]—which is a necessary precaution, since with greater knowledge of human nature and circumstances comes greater predictability of acts; but this does not reduce the province of mind. For Romanes all that is meant in the objective sense of mental adjustment is that it is "of a kind that has not been definitely fixed by heredity as the only adjustment possible in the given circumstances of stimulation."[2] But "it is not practically possible to draw a definite line of demarcation between choosing and non-choosing agents."[3] The common sense distinction is valid, as in zoological classification.[4] It is asked (significantly enough): "Does the organism learn to make new adjustments, or to modify old ones, in accordance with results of its own experience?"[5] Heredity cannot have provided in advance for alterations in its own machinery.[6] But there may not be enough mind for the learning to make new adjusments, or there may be defective memory, and some parts of our own nervous system not concerned in consciousness may learn by experience.[7] The practical danger is in not seeing mind enough.[8] The criterion is of "the upper limit of non-mental action, not of the lower limit of mental."[9]

The above gives the view of Romanes on the criterion of mentality. The vagueness and inconsistency that strike the reader are not due to misrepresentation. Other psychologists and biologists, also, take positions similar in this as in other respects.

M. Binet accepts Romanes' criterion of choice,[10] but seems not to know definitely how it is to be used, or what results it may give.[11] Prof. James says: "The pursuance of future ends and the choice of means for their attainment are thus the marks and criterion of the presence of mentality in a phenomenon;" the end is fixed while the pathway may be indefinitely modified.[12] The beginning for Cope is conscious memory, with the consequent possibility of more exact adaptation or design in an act.[13] Rapid and transient response in direct answer to certain changes in the environment seems to be Prof. Lloyd Morgan's criterion of mentality.[14] Wundt's view is this: "That the creature knows its proper food, and may be determined in its knowledge of it

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[1] *Ibid.*, 18. [2] *Ibid.*, 18. [3] *Ibid.*, 19.
[4] *Ibid.*, 19. [5] *Ibid.*, 20. [6] *Ibid.*, 21.
[7] *Ibid.*, 21. [8] *Ibid.*, 21. [9] *Ibid.*, 22.
[10] *Op. cit.*, 109. [11] *Ibid.*, passim. [12] *Op. cit.*, I, 7-8.
[13] *Loc. cit.*, 905.
[14] *Animal Life and Intelligence*, p. 243.

by previous impressions, is regarded as the first and primal indication of the presence of animal, *i. e.*, mental life."[1] Memory, he believes, is presupposed in cognition, and the presence of cognition is the point to be proved.

Most of these positions are to be criticised for admitting more or less of the subjective, and none are perfectly definite and satisfactory. Purpose and choice, moreover, taken directly as evidence of the workings of mind in the animal world may, since Darwin, readily excite suspicion. There are, however, suggestions in nearly all the above, as well as even more plainly in Romanes, which point toward, and weigh in favor of, what may, perhaps, be the true or best criterion of mentality.

If we define mind by reference to consciousness, what then is consciousness? Mind has the function of producing in the acts of an organism adaptation to environment by direct adjustment. It is the accessory of reaction, the director of action. Our ideas and feelings have reference to motion or its inhibition. The mind is aware of effects and symbolizes causes. The presentation, or representation, or other form of *symbolization* of some environing circumstance, it seems, may be the distinguishing attribute of mentality. For the development of this characteristic power of symbolization, retention or memory is necessary. Discrimination is but a means to more adequate representation. Symbolization, then, is the essence of consciousness.

In view of the function of representation, would it not follow that learning by experience, and the alterableness of action that this implies, furnish the best objective criterion of mentality? There would, in that case, be an intelligent as well as a selective response to environment. There would be *rectification* of action in the fullest sense. Selection, of kinds at least, may be merely mechanical, and it certainly may be merely physiological or unconsciously reflex. But what can sudden alteration in action as a result of experience, without a difference in environment, mean, other than a changed idea of the environment and better knowledge of its effects? Mere physiological habituation would come more gradually.

"Learning by experience" as the criterion of mentality is not new. The suggestion came to the writer from a critical study of Romanes' "Mental Evolution in Animals," ch. I. Though only incidentally, this criterion is actually given in so many words. Since committing to paper his ideas on this subject, the writer has been confirmed in this position by finding that the same criterion has been used explicitly by at least one biologist, while others have had practically the same idea. Dr. Bethe, although his psychology is bad enough, expressly makes

[1] *Lectures on Human and Animal Psychology* (trans.), p. 347.

modification of action through experience the test of mentality.[1] His "Lernprocess," "Erinnerungsprocess," "Lernfähigkeit" are only too rigidly used. After the manner of many biologists, he would exclude mentality till we are sure of its presence. He does not regard the requirement that mind must have evolved considerably before this test is applicable, and, though he explicitly explains the rise of mind by survival value in the face of selection,[2] be overlooks the difficulty touching reflexes. Rabid Weismannism also affects his views. Another biologist, Prof. Loeb, makes "associatives Gedächtniss" the criterion,[3] but in application it seems to be practically identical with learning by experience. He is to be criticised for going to the inferred subjective process instead of stopping at the simple objective fact.

Thus we seem to have a sure test for the presence of consciousness, but it is not necessarily the only one. Another criterion may be preferences unaccountable without reference to an affective element. This seems to be the essence of the choice criterion as M. Binet uses it. Such a test, however, should be employed with great caution, because so much of this unaccountability may be due to our ignorance. But especially preferences different and even opposite with change only in degree of stimulation—instance the reaction of bacteria to oxygen—cannot easily be thought of as merely mechanical, a simple *tropism*. The broader use of the criterion of choice, on the other hand, at least as applied to test the presence of consciousness in particular acts, seems to be valid only so far as implying alterableness and resourcefulness in action, *i. e.*, learning by experience. The reader notices this element in Prof. James as well as in Romanes.

Learning by experience, indeed, is not an all-sufficient and final criterion of whether a being is to be considered mental or non-mental. It is a *sure* test of the *presence* of consciousness, partly just because it requires a considerably evolved consciousness, and this we cannot suppose came into being *de novo*. Lack of mentality is not proved by absence of evidence for learning by experience. Symbolization does not necessarily imply the power of change in symbolization. Those biologists are wrong, and not so scientific as they think, who *deny* conciousness where it is not proved. Incipient stages of consciousness there must be. Yet we cannot know definitely where these beginnings are. And not only is the criterion defective on this side, but careful observation under all possible condi-

[1] Art. in *Pflügers Archiv*, 1898, pp. 19–23 particularly.
[2] *Ibid.*, 18.
[3] *Pflüger's Archiv*, Vol. LIX.

tions is required. It is not the customary and regular movements of micro-organisms, for example, that, according to this criterion, decide their capacity. It is rather the unusual and out of the way in movement, just what the biological student is most likely to miss, and, indeed, to think not worth looking for.

Even the simplest relation of consciousness to action in the particular case, moreover, as is evident, cannot be treated without reference to the relation between consciousness and animal movement in general. It is necessary to consider separately the mental character of the act and the possession of consciousness by the organism which acts. The one does not imply the other. Thus a secondary reflex act is mental in origin, while it is unaccompanied by consciousness. No kind or degree of complexity in reaction, so long as the phenomenon is simply different response to different stimulus, can prove the presence of consciousness; and even a change in response, if it is not sudden or transient, may arise from internal causes that we should call physiological rather than psychological. But it seems impossible satisfactorily to explain the *origin* of certain complex modes of reaction without bringing in consciousness. Its aid, in some other cases, too, we may believe would be an economy, since adaptations merely physiological are hardly capable of everything. There must be limitation somewhere from the nature of the physiological elements. All this means that not much reliance is to be had in negative conclusions drawn from the application of our criterion, whether they refer to a particular act, to an individual, or, as we shall see, to a race.

It is presumable that some adaptations which are strictly mental or conscious in origin have lost their conscious or mental character in the particular individual. Perfect adaptation to environment, through conforming all acts to absolute rules, would perhaps mean, in the simpler organisms, even the entire disappearance of consciousness. Some instincts seem to be sets of actions approximated to this character, and they may best be regarded as racial reflexes, so that an instinctive act need not involve the presence of mind or consciousness in the agent, though mind may have performed its function of adaptation in this matter and consciousness may then have disappeared. Indeed, Cope's position, perhaps not consistently held to, is that mind embraces "the unconscious derivatives of conscious antecedents."[1] Again he says: "Consciousness may be supposed to be necessary to the performance of an act which displays a definite relation to the satisfaction of some need of the animal, but such an act does not necessarily prove that consciousness is

[1] *Loc. cit.*, 900.

necessarily present at the moment of action."[1] And specialization of function, completed education, for him "means unconsciousness, while consciousness is necessary to the beginnings of education and its successive steps up to completion."[2] The possibility, therefore, is to be taken account of, that in lower organisms all mind may have passed into the reflex stage after adapting the species to its environment. So consciousness may have disappeared from species originally possessing it.

It would be desirable to formulate a definite criterion for the mental origin of organic movements. But general resemblance and connection by fine gradations with acts known to be conscious seem to be the best marks at present available. "Choice" in some sense may be the criterion here, but if so it has yet to be carefully defined and the mode of its application developed. The above quotation from Cope suggests a possibility in this direction. Romanes, also, says that indications of choice are indications of consciousness, but as reflexes have the same appearance, the test is whether the adjustments are invariably the same under the same circumstances of stimulation.[3] Thus Romanes himself seems to use the criterion of choice only for what, on one theory of reflexes, would be the remote effects of mentality on action, and in practice, learning by experience as a test for the presence of consciousness behind the particular act. In any case, the criterion at present sought is only to determine whether consciousness is now present in certain forms of life.

In considering protozoa in the light of the foregoing it is important to note that existing species could in nowise represent the first forms of life in respect of mentality. Protozoa are not proto-organisms in the sense of primitive or original forms of life, though they probably resemble these, in external attributes, more closely than does any metazoon. In fact, just in proportion as the *forms* of protozoa and their circumstances of life resemble those of the first forms of life, must the former depart from the latter, supposing the latter to have possessed the germs of consciousness in their psychology.

We are now in possession of what seems to be a definite criterion of mentality. Careful study of the movements of lower animals, with preconceptions such as those here combatted out of the way, should reveal something of their mental condition.

In the study of protozoa from a psychological point of view, although hardly anything can be more interesting and signifi-

[1] *Ibid.*, 901.
[2] *Ibid.*, 903.
[3] *Op. cit.*, 17.

cant, little has been accomplished, both because of inherent difficulty and because of biasing preconceptions. It is not the structure of protozoa, to which the zoölogist is almost exclusively attentive, nor even their regularly performed functions, more likely to be stereotyped in reflexes than to be conscious, that are of most importance from a psychological point of view. Hence the dearth of observations necessary to complete this Study.

M. Binet's little book is a convenient starting point in an examination of the facts bearing on the question before us. He finds plenty of evidence to show that at least some protozoa have something that corresponds to our sensations, especially touch, sight, and taste. He believes, also, that there is the capacity of localizing and even, in one species at least, the perception of position in tri-dimensional space.[1] Instincts he finds, in at least one case, of remarkable development.[2] These organisms spontaneously control many and complex motions. Preferences are shown for certain objects of food such as seem to involve degrees of pleasantness in gustatory sensations.[3] Similar seemingly affective preferences are exhibited by bacteria for certain colors of the spectrum.[4] Also, in some cases, moderate degrees of intensity of stimulation are sought, while greater intensities are fled from, so that the attraction here could not be merely physical.[5] On the whole, however, the evidence collected by Binet is in a confused state, and he seems unable to determine what is decided and what not.

Prof. Max Verworn has made a careful study of protozoa with

[1] *Op. cit.*, 53–4, 61, 63–4. J. Soury, in the *Revue philosophique*, Vol. XXXI, attacks Binet's book. He alleges (p. 37) incorrectness of observation in the case of *Diniduum Nasutum* cited. Soury offers no new evidence, and in theory is decidedly bad. He mixes Verworn's theory of consciousness with the belief in a thorough-going chemical physiology, and for the rest his work is characterized by multiplicity of "tropisms" and inconsistencies. In general, as regards the advocacy of tropism, it should be remembered that tropism at its best, *i. e.*, as mechanical attraction, should obey the law of inverse squares, proportional intensity, etc.

[2] *Ibid.*, p. VI. Questioned by Soury, *loc. cit.*, p. 38.

[3] Binet himself cites a different explanation by Maupas, *op. cit.*, 41, 45, 47, 62–3. The writer has hit upon the following, which supports Binet. "Although in two instances the animal [an Acinetan] was observed to capture ciliated Infusorians, its preference is decidedly for the Amœba, which are abundant in the aquarium referred to." C. C. Nutting, *American Naturalist*, Vol. XXII (1888), p. 14. Another series of observations indirectly significant is that of Metschnikoff, showing preference by phagocytes, especially of dead to living tissue.

[4] Binet, pp. 33–4. Wundt also says: "The fact that even the protozoa congregate in light of one quality and avoid spots illuminated by that of another must depend on some original sensation character and pleasantness." (*Lectures*, trans., p. 348.)

[5] Binet, 34, and *cf.* 38.

reference to their psychology, and that without damaging preconceptions, though perhaps with the biologist's drawback of thought only for the regular functioning of these simple beings. His peculiar and questionable theory of self-consciousness, however, and his indefensible definition of consciousness according to which it involves self-consciousness,[1] make necessary a reconsideration of his conclusions. He finds that response to stimulus has a mechanical rapidity and sureness, and constancy of form.[2] He cites one instance of injurious tropism, but it is where the stimuli to that degree are not usual.[3] He concludes that stimulated movements are reflex, and spontaneous movements impulsive and automatic, in his own sense of the terms.[4] "Bewusste psychische Vorgänge in dem Sinne, wie wir sie als Gegensatz zu unbewussten bezeichnen, können bei Protisten noch nicht vorhanden sein," although the germ of consciousness is there,[5]—this in his own sense of conscious. The general drift of his observations would seem to point to the conclusion that the protozoan mind has passed into the reflex stage. Yet one cannot be too cautious in drawing fixed conclusions. No one would now-a-days deny consciousness to rats and mice. Yet a rat or mouse with hind feet cut off will go through the ineffective motions of scratching with them, all his life, without difference in frequency and vigor.[6]

One particularly noteworthy piece of evidence for consciousness in protozoa, moreover, deserves to be cited. Hodge and Aikins have made observations not only valuable for results, but quite as much so for method. Although the observation was made not for psychological purposes, the following is recorded: "We attempted to obviate this difficulty by sterilizing the water supply, and by boiling and covering antiseptically, at the same time giving in the place of their normal food a pure culture of yeast plants. This attempt resulted in an interesting demonstration of the educability of Vorticellæ. At first they took this, to them, newly discovered food with great avidity, filling their bodies to distension with food vacuoles of the yeast. In a very few minutes, however, the entire meal was ejected with volcanic energy. Not a single torula was allowed to remain in the body, and for several hours at least—how long the memory lasted was

[1] *Psychophysiologische Protistenstudien*, Jena, 1899,. pp. 133-6, 143-5, *e. g.*
[2] *Ibid.*, 137.
[3] *Ibid.*, 139-40.
[4] *Ibid.*, 140-41. But *cf.* Cope's words, *loc. cit.*, 903: "All authorities agree that some of the actions of the Infusoria are in no sense automatic, but display a design as appropriate to the occasion as do those of the higher animals."
[5] *Ibid.*, 145-6.
[6] *Cf.* Romanes, *Darwin and after Darwin*, Vol. II, p. 80-81, ftn.

not determined—the individual could not be induced to repeat the experiment."[1]

It is true that this result stands alone, but the method of observing protozoa seems to be quite as much alone.[2] Such experimental variation of conditions with patient continuous observation and careful record, not merely of ordinary, but also of extraordinary occurrences, is just what is needed. It is not here the business of the scientific man to find a constant. It is from observations yet to be made that we may hope to learn something of the psychology of protozoa.

In conclusion, it must be admitted that this paper can at most only clear the way for observation that may lead to results. At present materials are inadequate, in respect both of quantity and kind.

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[1] "Daily Life of a Protozoan," *American Journal of Psychology*, Vol. VI, p. 530.

[2] In a valuable paper, *The Psychology of a Protozoan*, in the *Am. Jr. of Psych.* for July, 1899, H. S. Jennings sets forth certain results obtained from careful study of the Paramecium. He finds it possible to explain by a single simple reflex reaction to stimulus, no matter what or where applied, all the seemingly complex psychical phenomena exhibited by this animal. The response he believes to be in exact analogy to the irritability exhibited by the isolated muscle of a frog. The significance of the character of stimuli, however, deserves emphasis. The fact of an optimal temperature and of reaction not in proportion to the intensity of stimulus cannot, at least, be explained mechanically. If Paramecia, moreover, gather "indifferently about loose fibrous bodies of any sort," there is a suggestion of something corresponding to the sensation of touch. These facts, it is true, may be called merely physiological; but who can distinguish the merely physiological from the degenerate mental? Does not this suggest the possibility that the physiologist has at least something to learn from psychology as well as from chemistry and physics? It is not the least merit of Dr. Jennings' paper that he attempts no mechanical explanation of the nature of protozoan activities. He would probably admit that it is only a figurative use of words when he speaks, at the conclusion of the article, of "the machine-like nature of its [the Paramecium's] activities." It is always proper to demand of the one who would explain everything mechanically that he *draft* his machine. Until he does this his task is incomplete. Incidentally the importance given to "learns nothing," in the concluding sentence, may be remarked, as showing what sort of evidence is sought.

PSYCHIC RUDIMENTS AND MORALITY.[1]

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OUTLINE.

§ 1. THE LAW OF DIFFERENTIATION.

The first law of development, and one too well known to need elaborate illustration, is that of differentiation. Animal life begins with unicellular organisms, many of them less than a thousandth of an inch in diameter, and develops by proliferation of cells into all the diverse species of the animal series. The simpler Protozoa perform the functions necessary to their existence without specialized organs, moving from place to place, absorbing and assimilating their food and reproducing their kind by processes in which the whole body is involved. Among the Metazoa, these functions cease to be performed by the organism as a whole and are distributed more and more to specialized organs, until in the higher animals we find highly complex nutritive, reproductive, motor, and nervous systems.

The same law, of course, is operative also in the development of each individual. The human being begins life with a single cell something like the 125th of an inch in diameter. This cell divides and subdivides, until in the adult body we find 26,500 billion cells, built up into the vast variety of bodily organs. In this development of the individual, phylogenetic history is recapitulated. Each group of organs reveals, with varying

[1] I am under great obligations to the entire psychological faculty of Clark University for help in the preparation of this article. Especial acknowledgments are due to President Hall, who suggested the topic and supplied constant inspiration and guidance in working it out; to Professor E. C. Sanford, who gave valuable advice and assistance in the revision of manuscript; and to Mr. Louis N. Wilson, who helped me to procure books of reference not readily accessible.

degrees of distinctness, the process of differentiation from simple to complex types of organization.

The same law holds, moreover, for the mind as well as for the body. The different elements are more difficult to trace in their beginnings and development than are organic structures, but the general fact of their increase in complexity is clear. From the close relation of the instinct-feelings to the welfare of the organism, it might be inferred *a priori* that the same general law would operate in one case as in the other. Darwin apprehended this truth when he said:[1] "It will be universally admitted that instincts are as important as corporeal structures for the welfare of the species, under its present conditions of life. Under changed conditions of life, it is at least possible that slight modifications of instinct might be profitable for the species; and if it can be shown that instincts do vary ever so little, then I can see no difficulty in natural selection preserving and continually accumulating variations of instinct to any extent that was profitable. It is thus, as I believe, that all the most complex and wonderful instincts have originated."

Did space permit it would be easy to show this growing complexity of the psychic life by abundant citations, but the point is not one that is likely to be contested.

§ 2. The Law of Elimination.

Differentiation is only the positive aspect of development. There is also a negative aspect, illustrated in the correlative process of elimination. As life is brought into more complex relations with environment, it requires new organs to mediate its functions. Meanwhile old organs cease to be serviceable and fall into disuse. When vertebrate animals began to leave the water they were unable to breathe air by means of gills. Accordingly, their change of habitat involved the development of lungs, and the gills fell into disuse. Again, when vertebrate animals took an upright position and commenced to walk upon two legs instead of upon four, various modifications became necessary. The triradiate pelvis would not support the viscera adequately; the keel-shaped thorax would not accommodate itself to an upright position or admit of the freedom of movement in the fore-limbs that was necessary; and the whole complex of muscular structures was out of adjustment. Accordingly, the transition from a horizontal to a vertical position of the body involved an expansion of the pelvis, a flattening of the thorax, and a readjustment of the muscles; and these changes rendered certain organs like the sternal ribs and various muscles functionless for their original purpose. Function-

[1] *Origin of Species:* Vol. I., p. 321.

less organs are also found in psychical development. When animals became terrestrial a vast complex of new instincts had to be formed, and a corresponding complex of instincts that served the ends of aquatic life fell into disuse. Every stage in the advancement of mankind, from a life dependent upon the chase to that dependent upon agriculture and other settled industries, has involved new instincts and types of intelligence, and the disuse of old ones.

The elimination of all such functionless organs, psychical as well as physical, has therefore been as necessary in the economy of Nature as has been the differentiation of new ones. The two processes are everywhere concomitant. But elimination is slowly accomplished. The useless organ yields by degrees, and often persists in the midst of environments that are vastly more complex than those in which it normally functioned. Everywhere in nature rudimentary and aborted organs point to a past inconceivably remote. These it is that establish the law of elimination, inasmuch as they are clearly undergoing regressive change. The nature of such rudimentary organs has been defined by Wiedersheim as follows:[1] "By such organs are meant those which were formerly of greater physiological significance than at present. In the course of generations, in consequence of the adaptation of the body to special conditions of life, they have been, so to speak, put out of the running, subjected to reduction or degeneration, and now persist as mere vestiges." The law of elimination illustrated in such a reduction of structures is thus stated by Darwin: "It appears probable that disuse has been the main agent in rendering organs rudimentary. It would at first lead by slow steps to the more complete reduction of a part, until at last it became rudimentary, as in the case of the eyes of animals inhabiting dark caverns, and of the wings of birds inhabiting oceanic islands, which have seldom been forced by beasts of prey to take flight, and have ultimately lost the power of flying. Again, an organ useful under certain conditions might become injurious under others, as with the wings of beetles living on small and exposed islands; and in this case natural selection will have aided in reducing the organ, until it was rendered harmless and rudimentary."[2] Such evidence of the action of the law of elimination, to speak first of the physical organs, is found in bewildering abundance when search is made for it, and that not only in plants and animals, but in man himself. In his case embryology and comparative anatomy have accumulated a mass of data as

[1] *Structure of Man*, p. 2.
[2] *The Descent of Man*, p. 401.

astonishing as they are conclusive. Wiedersheim[1] enumerates more than a hundred structures and groups of structures that are either regressive or shifting in position. Many of the groups, moreover, include a large number of individual organs, as, for example, the muscular groups. Now, if one can imagine each of these structures and groups of structures to be fully developed organs, instead of more or less unobtrusive rudiments, he will have before him a type of what the human body would be had not the economies of nature been so administered as to eliminate the useless.

Psychic rudiments have thus far received comparatively little attention from psychologists. They are, however, as much a logical corollary of the theory of evolution as are the regressive structures in the physical organism. The doctrine of the latter, before the time of von Baer, was largely an inference awaiting proof or disproof. As has already been seen, it is now as well established as any other law of comparative anatomy and embryology. Darwin recognized the existence of the parallel psychical law. Thus, in speaking of regression in relation to moral qualities, he says:[2] "Some elimination of the worst dispositions is always in progress, even in the most civilized nations. Malefactors are executed or imprisoned for long periods, so that they cannot freely transmit their bad qualities. Melancholic or insane persons are confined or commit suicide. Violent or quarrelsome men often come to a bloody end. . . . Intemperance is so highly destructive that the expectation of life of the intemperate, at the age of thirty, for instance, is only 13.8 years; while for the rural laborers of England at the same age, it is 40.59 years. Profligate women bear few children, and profligate men rarely marry; both suffer from disease. . . . With mankind, some of the worst dispositions, which occasionally without any assignable cause make their appearance in families, may perhaps be reversions to a savage state, from which we are not removed by very many generations." A like recognition of the paleogenetic origin of many psychical attributes that are now discordant factors in civilization would probably be accorded by most comparative psychologists. But the idea of deriving the present psyche from a more primitive one has not found such definite expression in psychological literature as has the correlative idea of organic derivation in the literature of comparative anatomy.[3]

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[1] *Structure of Man.* This work may be consulted for abundant confirmation of the law under discussion. See also §§ 4, 5 and 6 of this article.

[2] *Descent of Man*, p. 153.

[3] Recently, however, Pres. Hall has made full use of this idea in the analysis of a group of instinct feelings (*cf.*, A Study of Fears. *Amer-*

§ 3. Modes of Elimination.

Granted the general operation of the Law of Elimination the next question is as to the methods by which elimination is accomplished. There are three principles which are deducible from the phenomena of regressive transformation in organic and psychical life:

1. *The process of elimination is slow.* Nature does not abruptly extirpate an organ as soon as the conditions that brought it into being and made it serviceable have passed away. When the fishes of Mammoth Cave found their present habitat in subterranean waters, they undoubtedly had eyes like those of other fishes. These eyes, however, must soon have become functionless. Now, hundreds of generations of such animals have come and gone, each living in total darkness. Yet the work of eliminating the functionless structures of sight is not completed; rudiments of eyes still appear, recalling the far-off ancestors that disported themselves in sun-lit waters. Darwin says in regard to the gradual processes of Nature in this respect:[1] "It may be doubted whether a change of structure so abrupt as the sudden loss of an organ would ever be of service to a species in a state of nature, for the conditions to which all organisms are closely adapted change slowly. Even if an organ did suddenly disappear in some one individual by an arrest of development, inter-crossing with the other individuals of the same species would tend to cause its partial reappearance, so that its final reduction could only be effected by some other means."[2]

Psychical elimination is also slowly effected. This is shown in the feral instincts and habits of domestic animals, which persist hundreds and it may be thousands of years after they have ceased to be functional in a strictly economical sense. Among men, the same feral psychoses, with their fondness for strange foods and primitive ways of securing them; their uneconomical and dangerous sex proclivities; their multitudes of fears of animals, men, and other objects; their superstitious beliefs about dreams, ghosts, and celestial phenomena; and their sinister passions of anger, jealousy, envy, and oppression, indicate the inertia of the human soul and its resistance to radical processes of change. No one that has studied history and current civilization, or the phenomena of ontogenetic growth as revealed in himself and others, can be ignorant of

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ican Journal of Psychology, Vol. VIII [1897], pp. 147–249), and has been followed in it by several of his pupils.

[1] *Plants and Animals under Domestication.* Vol. II, p. 308.

[2] *Cf.* a remark on the excessive slowness of organic change, by Weissmann. *The Monist*, Vol. VI, p. 255.

the tremendous truth that Nature is on the side of the best aspirations and the best efforts of the race. But, as Nature has reduced the number of superfluous ribs only by a process extending over hundreds of centuries, so must the forces that make for psychical evolution gradually effect those variations which shall adapt men to the conditions of a more complete existence.

2. *Elimination is effected through the atrophy of structures or qualities.* This is the usual method in organic variations. Disuse normally leads to regressive change in tissues, since the metabolic processes are interfered with by any decrease in the functional activity of organs. Psychical atrophy is illustrated in the disappearance of instincts and habits. All the domestic animals must at one time have been more or less migratory, yet the instinct has now disappeared in most cases. The same may be said of their fear of man. In fact, every young animal in a state of domestication recapitulates the process of taming that its species has undergone at the hands of man, and this recapitulation is a kind of ontogenetic atrophy by which the resurgent instincts are again reduced.

In man, there can be no doubt that, grossly considered, all the instinct-feelings have been modified in the direction of less intensity. The appetite for food is not so voracious among men as it is among animals, and not so voracious among civilized peoples as it is among savages. The same is true of the sex-instinct. Among the lower races the latter is much stronger than it is among the higher races. This is especially true in the case of women. Both on anatomical grounds, and for psychical reasons as well, the female savage is more erotic than her civilized sister, as the investigations of anthropologists have shown. The fear and anger psychoses have also been greatly reduced as a whole, as have the related malevolent instincts. What is true of the race is more especially true of individuals. In many men and women, it must be owned by the most pessimistic that the food and sex instincts are entirely under control. Temperance in the one and continence in the other are realized facts, life being practically emancipated from the bondage to those appetites. In many individuals, also, atrophy of the cruder fears and the more malevolent passions has advanced so far that these qualities are rendered harmless. The fact that such transformations are so nearly completed in some individuals of the race points the course of evolution, for general progress first comes to light through sporadic variations.

3. *Elimination is sometimes effected through transformation of function.* Darwin says:[1] "An organ may become rudimen-

[1] *Origin of Species*, Vol. II, p. 257.

tary for its proper purpose and be used for a distinct one. In certain fishes the swim-bladder seems to be rudimentary for its proper function, but has been converted into a nascent breathing organ or lung. Many similar instances could be given." The transformation of function becomes possible through the fact that an organ commonly has not one function but a number of functions to perform, of which functions one is predominant at any given moment, and the rest are subordinate. "Each function is a resultant of several components of which one is the principal or primary function, the other secondary. Diminution of the primary function and increase of a secondary function alters the total function; the secondary gradually becomes the primary, the total function is changed, and the issue of the whole process is the transformation of the organ."[1]

There are many illustrations of this principle in organic development. Man's arms illustrate a change in function from locomotion to their present uses. The teeth of various animals, which were once used as a means of defense, have been modified and adapted to purposes of mastication. The human tongue, which originally functioned as an organ of alimentation, is now also an organ of speech. This is perhaps the nearest approach in nature to a transformation from physiological to psychical functions.

On the psychical side, we find illustrations of change in function in the sex-diathesis. The entire group of courting instincts have been progressively modified in the direction of conjugal, parental, and social instincts. In the very lowest animals union of the sexes and the deposition of eggs summed up the phenomena of reproduction. Then came the love of offspring, which has since been transformed through countless differentiations into life-long affection and care, not only for one's own children but also for the children of others. The transformation of a desire for union with the opposite sex into conjugal feeling was more slowly, though not less surely, accomplished. At first, sexual relations were possibly indiscriminate; then they were modified by temporary associations of the sexes; then by polygamous marriages, which made such associations more or less permanent; and finally, by monogamous marriages, whose ideal is expressed in the marriage rituals of Christianity, binding the sexes together in "holy wedlock" as long as life shall last. Illustrations of sex transformations are numerous among the individuals of every civilized community. Boys, who in adolescence recapitulate the sexual instincts of their phylum, find the sex yearnings of mature life satisfied by the chastest of companionships with

[1] Marshall: *Biological Lectures and Addresses*, p. 59.

women, and by such sexual amenities as politeness and deference to every woman they meet. Girls in whom conjugal and maternal instincts are rife during early womanhood become women whose sex yearnings are satisfied by intellectual companionships, or by labors of love among the children of other women,

The transformation of fears is not less remarkable. Among animals, fright, terror, timidity, dread, and distrust are everywhere powerful emotions. In man, these become transformed into caution, respect, bashfulness, awe, and reverence. Similarly rage, hatred, revenge, etc., have more and more yielded to altruistic forms of indignation. While even jealousy and envy may be transformed into a spirit of emulation that is healthy and economical when the ends to be secured are worthy.

§ 4. The Law of Persistence and Arrested Development.

The Law of Persistence is the natural antithesis of the Law of Elimination. The process of elimination that normally accompanies development is sometimes retarded or arrested. The struggle for existence is nowhere more rigorous than among the structures of the body and the attributes of the soul. Matter is inert and resists the organizing force that elaborates it into higher and higher forms. It is always seeking lower levels of organization, and, unless the circumstances are favorable, creative energy is overcome and development becomes retrogressive. Psychical evolution is not less difficult. There is an inertia of soul as well as of body. Even under normal conditions the pull downward is only a trifle less strong than the push upward, and this unstable condition is always in danger of being inverted. It would seem that in the world of mind as in the world of matter "there is a tendency for energy to pass from the higher or more readily transformable to the lower or less readily transformable forms." Low potential existence is easy; high potential existence is difficult.

Let us come to closer quarters with the facts.[1] The tendency of life to seek lower levels is shown first in the reappearance of structures and types peculiar to lower developmental stages. This results proximately from the fact that ontogenetic devel-

[1] The same set of facts shows the operation of both the Law of Elimination and that of Persistence; a rudimentary organ is evidence of the process of elimination in that it is rudimentary and of the tendency to persist in that it exists at all. The facts enumerated in the following sections will therefore serve as evidence for the truth of both principles, and make up in part for the meagerness of citations in the previous sections.

opment is recapitulatory. Each individual passes through the stages through which its phylum has passed. If for any reason, therefore, development is arrested at a point corresponding to one of these lower stages, the qualities characterizing the latter will persist. We have here to distinguish between growth and development. *Growth* results from the augmentation of each of the parts of a body, independent of all change in their number, structure, or functions; *development*, on the contrary, consists of differentiation of the organism into a greater number of structures and into greater complexity of structures and functions. The two processes, while normally correlated, may take place more or less independently. Thus, if a tadpole is kept excluded from light and heat, but at the same time is supplied with food, it may *grow* into a gigantic tadpole, but never *develop* into a frog. This is what is meant by "arrest of development;" there has been simply augmentation of the parts of the tadpole's body without any change in their number, structure or functions. In other words, the enlarged tadpole is just as homogeneous as the small one. Thus, arrested development renders persistent the peculiarities of the stage at which it takes place, while the augmentation of these qualities through continued growth throws them into greater and greater prominence.

1. *Organic Arrests.* The structures of the human body that are normally vestigial, and appear only at certain stages in the development of the embryo, sometimes become persistent. (1) The *branchial sacs* found in the embryo, occasionally persist into adult life, penetrating the anterior cervical region and even opening into the pharynx. Fisher[1] found that in sixty-five persons thus affected there were 79 clefts, 51 being unilateral, and 14 bilateral. Twenty cases opened into the pharynx, and 53 did not. There were thirty-four males showing this anomaly and thirty females, and there was evidence of heredity in twenty-one cases. (2) The human embryo during the early part of its development is bisexual, having both the male and female genital ducts. At this stage, it resembles hermaphrodite forms of life. Later, the paired Müllerian ducts develop into the female genital system, and the Wolffian into the male genital system. Sometimes the early embryonic condition persists and grows into a more or less perfectly developed bisexual system. The result is human *hermaphroditism.* (3) At one stage in the development of the Müllerian ducts in the female, they are separated throughout after the manner of didelphous animals. Not infrequently this didelphous condition persists, and

[1] Quoted by Bateson: *Materials for the Study of Variation*, p. 175.

the result is the abnormal forms of uterus, such as *uterus duplex*, *biocularis*, *subseptus*, *bipartitus*, *bicornis*, etc. (4) At an early stage of embryonic life, there appears a free projecting appendage joined to the caudal vertebræ and resembling a tail. In time, this appendage normally becomes absorbed, and when the child is born no trace of the tail is left except the *vertex coccygeus*. But sometimes this absorption does not take place, and the tail persists into adult life. From the middle third of the present century, thirty well-authenticated cases have been recorded among civilized peoples. Thus Shaeffer mentions four cases of caudal formation, associated with other anomalies. Raband[1] reports the case of a boy who had a tail nearly a foot long. Wiedersheim[2] cites several cases: one, recorded by Gerlach, of an embryo with a true caudal appendage one-sixth of its length; and one, recorded by Lissner, of a female child that had a tail containing an axial continuation of the vertebral column. Kögel,[3] Schultze,[4] Freund,[5] and others state that these anomalies are common in Borneo, the Sunda Islands, and various places. (5) During the sixth month of its life, the human fœtus is entirely covered with a coat of soft hair called the *lanugo*. Normally, this lanugo marks only a recapitulary stage in the development of the corneous structures. Through an arrest of development, however, the fœtal hair may persist and grow into a permanent hairy covering. Wiedersheim mentions the Ambraser family, Barbara Uslerin, Julia Pastrana, the Russian "dog-man" Jeftichjeff, his son Fedor, and the Burmese Shewé-maong and his family. Of these, Jeftichjeff and Shewé-maong had the whole face thickly covered with delicate soft hair. The Russian's body was less hairy than that of the Burmese, which was entirely covered with hair from four to eight inches long. Flesch[6] describes a boy 2¾ years old, who was a light blonde in complexion and had a growth of hair upon either cheek. This hair was from 1.5 to 2 cms. long and very light in color. There was also a heavy growth of hair on the breast, shoulders, and back; this was thick, and 2.5 cms. in length. Stricker[7] describes a girl who lived in Augsburg during the 17th century. This girl was covered with a very fine silky white hair, and had a rather heavy beard of the same color and texture. Morgan[8] men-

[1] *British Medical Review*, August, 1891.
[2] *Structure of Man*, p. 29.
[3] *Globus*, Vol. XXXI, No. 5.
[4] *Zeitschrift für Ethnologie*, Vol. IX.
[5] *Virchow's Archiv*, Vol. CIV, p. 531.
[6] *Archiv für Anthropologie*, Vol. XIII.
[7] *Virchow's Archiv*, Vol. LXXI, p. 111.
[8] *British Medical Review*, July, 1891.

tions a tuft of hair in the middle of a boy's forehead, evidently hereditary, as it could be traced through four generations. This anomaly recalls a similar tuft of hair found on the head of the gorilla. (6) Another example of the persistence of a tegumentary rudiment is probably found in the disease called *ichthyosis*. This disease consists of a thickness of the whole skin in more or less regularly shaped scales. It is not well understood, but is known to be hereditary. It is not unlikely that it represents in a hypertrophied form the *stratum corneum* of the embryonic period, rendered persistent through an arrest of development at the epitrichial stage of the corneous structures. Very similar is the anomaly described by the writer of "Vestiges of the Natural History of Creation,"[1]—that of an Englishman who had semi-horny excrescences a half-inch long growing thickly all over his body. This anomaly was hereditary also, being traceable through three generations. (7) It seems probable that the brains of microcephalic idiots and some species of imbeciles represent exaggerations of rudimentary types of structure. Cunningham,[2] who studied the brains of two microcephalic idiots and compared them point by point with the brains of different species of monkeys, obtained the following results: (a) In general, the peculiarities group themselves according to three types—that of the higher apes, that of the lower apes, and that of quadrupeds. (b) The relation between the weight of the cerebrum and that of the cerebellum is similar to that found among quadrupeds. (c) The arrangement of convolutions in one of the brains is more ape-like than human. (d) A number of sulci and gyri are similar to those of apes. And (e) there is a marked reduction of that part of the hemisphere which lies behind the fissure of Rolando. Mickle gives the following variations in the parieto-occipital fissure, each of which is present in certain ape forms, some microcepheles, and some fœtuses: (a) An internal limb of parieto-occipital fissure interrupted by a superficial *gyrus cunei*, or other annectant gyri, which has attained the surface. (b) Doubling of the internal limb of the fissure, shortness of it, failure to reach the upper border, slightness of its incision there. (c) Its defective depth and boldness relatively to the calcarine. (d) Spurs running fore and aft from the internal parieto-occipital limb, furrowing and practically expending themselves on præcuneal surfaces, or shallowly touching the upper hemispheral edge. (e) Confluence of the conjoint "stem" of calcarine and parieto-occipital with col-

[1] Anonymous. But a pioneer work in literature of evolution. Published in 1852, at Cincinnati.

[2] *Journal of Medical Science*, Vol. XLII, p. 541.

lateral fissure. On the side of more minute anatomy, Bevan Lewis[1] has found in the brains of epileptic idiots a type of cells that normally appear in the cortex of the apes. These are the inflated spheroidal cells that are distinguished, not only for their peculiarity of contour and nuclear structure, but also for the paucity of their branches.

2. *Psychical Arrests.* The general type of arrested psychical development is the *idiot.* All classes of idiots illustrate the persistence of qualities found among animals, but usually appearing only in the lowest developmental stages of man. Their intelligence is feeble, they are incapable of attention, and they are extremely imitative. In the microcephalic type they are unable to speak, and are fond of gambolling about on all fours, running up stairs, climbing trees, etc.[2] Several cases are recorded where they smelled every morsel of food before eating, and one idiot used his mouth in hunting lice from his body. They are usually filthy in their habits, and have no sense of decency. Hunger is little inhibited, and usually leads to gluttony. The sexual instincts are uncontrolled when present. Masturbation is exceedingly common among all idiots of both sexes. Onanism, sodomy, and various other sexual psychopathies of a revolting nature are practiced by some in whom there is strong sexual desire united with an absence of moral perception. Destructive tendencies are common, the lower grades destroying through carelessness, but the higher grades often showing a malicious satisfaction in inflicting damage or injury. An inclination towards homicide, arson, etc., is not uncommon. Fear is often exaggerated, the simplest causes producing great excitement. Anger is manifested without reason, and is paroxysmal in character, leading to the infliction of injuries upon the individual himself, or upon other persons and inanimate objects.[3]

Arrest of psychical development may be illustrated more in particular by vagrancy, pauperism, theft, gluttony, drunkenness, unchastity and assault.

(a) *Vagrancy* and *pauperism* represent the persistence of the unproductive food-appetites found in animals, children and savages. The vagrant and pauper are social parasites par excellence. Many causes operate to produce such individuals, but incapacity to adapt themselves to social and economical conditions that oblige every man to work for a living is one of the most important. Cast little children adrift in the world and they will be helpless. Place men and women of the lower races

[1] *A Text-book of Mental Diseases*, p. 527.
[2] Darwin: *Descent of Man*, p. 52.
[3] Peterson: The Psychology of the Idiot (*Am. Journal of Insanity*), Vol. LIII, 1896-97, pp. 1-25.

in the midst of a civilized community and they will be almost as helpless as the children. Nor will this be altogether due to the disadvantages arising from changed environment; it will be due, in a large measure, to their incapacity for settled modes of life and routine occupation. This has been illustrated in the American Indians, who were brought within the influence of civilization by the incursions of Anglo-Saxon peoples. Few of the Indians have ever learned to work. As soon as the natural means of subsistence were exhausted they depended upon the government for support. Except as the wards of the white people who have appropriated their domains they could not now exist in many sections of the United States. A handful of Sioux Indians would starve to death without government supplies upon a reservation that would support in affluence a population of Anglo-Saxons ten times as numerous. A similar illustration is afforded by the Negroes. The native Africans are generally children of Nature, making very little effort to improve upon her methods of support. When they were imported to the United States and placed under white taskmasters they were obliged to work somewhat after the manner of the civilization surrounding them. But after they became their own masters and took their places as self-supporting members of a free society, the race instinct of carelessness and improvidence asserted itself. Many of the best men and women among them have indeed proved their fitness to survive by adjusting themselves to the conditions of free competition. But the great majority of them have not been able to do so, and will not be able to do so for centuries. It is not accidental that so many negroes like to sun themselves in the streets of southern towns and cities, or that throughout the country everywhere they so often content themselves with some chance means of subsistence, such as cleaning out ash-pits, laying carpets, blacking boots, running elevators, etc. While few negroes become vagrants or paupers in the strict sense of such terms, many of the race are satisfied to live in a manner that insures immunity from pauperism and vagrancy rather through an absence of wants than through an ability to supply them.

The general unadaptiveness of such primitive peoples to the economical conditions of civilization is reproduced in some men and women of the highest races. Their development has been arrested at a point corresponding to the improvident stage of appetite. In every civilized community there may be found those incapable of supporting themselves by regular employment. Such are the tramps and strolling vagabonds of every description, and such are most of the professional beggars and many of the pauper class. The statistics regarding such elements of society are extremely incomplete. Thousands of them

manage to keep out of the hands of the law through some makeshift of wit. But we know they are everywhere. According to the Poor Law statistics of Great Britain for 1880, there were at that time in England and Wales 5,914 vagrants, and 808,030 paupers. In France, among the prisoners sentenced in 1882, 23 per cent. of the males and 20.5 per cent. of the females were committed for vagrancy and mendicity. In Switzerland, during the years 1870–74, 4.6 per cent. of the delinquents were vagrants. According to the United States census for 1890, there were at that time in public institutions of this country 2,843 adult vagrants, 1,336 juvenile vagrants, and 73,045 paupers, or 1,166 to every million of the population. While it would be incorrect to say that all these individuals are incapables from the standpoint of modern civilization, it is doubtless true that a large per cent. of them represent the type of arrested development here considered. It is the conclusion of M. Mounod, who investigated a large number of vagrants, that not more than one in forty would accept work if he could get it. This estimate would probably apply to the ubiquitous tramp of the United States.

Since all children pass through this stage of development, bad surroundings or disease often cause an arrest of development in those whom a bad heredity has not incapacitated already. From one or the other of these causes, boys and youth in comparatively large numbers go forth from every city and large town to swell the ranks of the parasitic classes. We find them in the truant schools, where they are sent because they will not, or cannot, adapt themselves to the conditions accepted by normal children. Later, the more pronounced cases of truancy may be found in the juvenile reformatories, where they have been sent for vagrancy or some other offense reducible to a general incapacity to discharge the duties imposed upon them by parents or society. Thus, L., aged 12, was a stubborn, intractable boy who did not like to do any kind of work. He would run away from home and be lost sight of for several days or weeks. At last, his parents invoked the aid of the authorities and he was placed in custody for a time. As soon as he was released, however, he ran away from home and was gone for a year. Then he was returned by a benevolent society which had discovered him in a New York hospital, and was again given a trial at home. But he ran away once more, was captured by the police, and sent to a reform school. H., a boy of 14, was the son of pauper parents, was himself in an almshouse for several years, and was finally given to a farmer to bring up. He was a born vagrant, however, could not be brought to a settled occupation, and at last became so incorrigible that he was sent to a reformatory. C., a boy of 16, was

vagrant in his disposition from childhood. He ran away to sea several times and gave his parents so much trouble that they complained against him, and he was commited to a reform school. After a term of probation there he was placed upon a farm, but immediately ran away, made his way to Europe and was gone a year. Then he returned and became a vagrant, but was arrested and returned to the reform school. N., a girl aged 16, was of pauper stock represented in the Pembroke (Mass.) almshouse for the last sixty years. Was herself placed in an almshouse at 13, and has since been in state institutions. Was utterly incapable of consecutive work and was indolent and improvident. P., a girl of 16, was born of improvident parents who could not support their own children. Was placed in a charitable institution, but later found a home in a private family. Became vagrant and wayward, however; had an illegitimate child, and was finally sent to a reformatory.

With all these cases, the primary difficulty was an inability or unwillingness to adapt themselves to the restraints of home and society, and to resist the impulses towards an irresponsible wandering about and loafing.

(b) *Theft* represents the persistence of the predatory instinct. The thief has first of all a defective moral sense, but more particularly a defective sense of the rights that inhere in property. Concomitant with these defects, is a disposition to idleness, vanity, and general self-indulgence. The qualities constituting the diathesis of theft are therefore very primitive. Some of them are found in animals, others are especially characteristic of savage and semi-civilized peoples, while most of them are recapitulated in the life of very young children. They are all characteristic of stages of development wherein rights of property have not come to be recognized, and wherein the inhibitory influences of morality and intellectual prevision have not yet become strong enough to check the impulses towards self-gratification.

Animals have no sense of property. They plunder from one another indiscriminately. It is only in such higher animals as the dog that we begin to see a certain respect for property rights, so far as they pertain to the master. Savages have a sense of property only a little more fully developed. The rights of ownership are but slightly regarded. They appropriate what they want, and protect themselves from one another in a manner analogous to that of animals. The ancient Aztecs of Peru and Mexico preserved their property from pillage by collecting it in large huts, which they closely guarded. In Egypt, the government granted licenses to robbers, the only recourse of the people plundered being to purchase back their property. Even after a certain family and

tribal sense of property had been developed, the disposition to steal from strangers had full sway. The Spartans allowed theft and punished a captured thief, not for his offense, but because he was not adroit enough to keep from being caught. The early Germans taught their youth to plunder from neighboring tribes. According to Thucydides, the Greeks and all the barbarians of the islands and sea coasts practiced piracy, for glory as well as for booty. In eastern Africa, those who are expert in pillaging from neighboring villages enjoy general esteem. The Esquimaux are honest in dealing with one another, but never with strangers.[1] As is well known, children have no sense of property at first. They take one another's playthings and sweetmeats, and there is nothing safe from their ravages, from pantry to orchard. This disposition to appropriate other people's property yields but slowly as childhood advances. Little girls will pick up toys and bits of finery at neighboring houses, while boys will extend their depredations to the various fruit and game preserves of the entire community.

Now, stop the development of the child at this stage when he is living over the instincts and habits of his animal and subhuman ancestors, and you will have a type of the most numerous class of moral delinquents of which the law takes cognizance. The property sense, which in civilized communities is so indispensable, has been one of the most difficult to develop; and the correlated instincts of idleness and self-indulgence are constantly reinforcing the impulse to steal. In Italy, from 1880 to 1884, there were yearly 221 trials for theft to every 100,000 of the population; in France, from 1879 to 1883, there were 121; in Belgium, from 1876 to 1880, there were 143; in Germany, from 1882 to 1883, there were 262; in England, from 1880 to 1884, there were 289; in Ireland, from 1880 to 1884, there were 101; in Hungary, from 1876 to 1880, there were 82; in Spain, from 1883 to 1884, there were 74.[2] During the year 1882, 66 per cent. of the commitments to prison in France were for theft, in the case of male delinquents, while in the case of female delinquents, 52 per cent. were for theft. In Switzerland, from the year 1870 to the year 1874, over 70 per cent. of the commitments were for theft.[3] According to the United States census for 1890, 44 per cent, of the inmates of penal institutions in this country were confined for theft of some kind.

The following illustrations of the forms this kind of arrested development may take are drawn from a typical community:

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[1] Lombroso: *L'Homme Criminel*, pp. 65–68.
[2] Morrison: *Crime and its Causes*, p. 129.
[3] Ferri: *Criminal Sociology*, p. 33.

D., a boy of 15, was idle and vagabondish in disposition. His parents could not keep him in school or at work of any kind. He acquired the habits of smoking cigarettes, drinking, and going to the theater. His parents would allow him no money for such indulgences, and he took to stealing. At first he "sneaked" cigarettes, bottles of beer, etc., from the stores, then he stole money from cash drawers, and finally he stole a horse, sold it in a neighboring town, and squandered the money in drinking and going to the theater. For this he was committed to a reformatory. M. and J., aged respectively, 14 and 12, formed the habits of running the streets and smoking cigarettes. Their parents tried to correct them, and refused them spending money. They began to steal small sums from their parents, then from the neighbors and from cash drawers in stores; then organized a band of twelve boys and systematically looted tobacco stores for a year, dividing the booty and pledging one another to secrecy. At last they were detected in the act of burglarizing a store, and were sent to a reformatory. T., a boy of 18, well connected and holding prominent social and business positions, began to lead a fast life. His expenses for clothing, theatricals and card parties exceeded his income, and he began to forge checks and otherwise obtain money under false pretences. He squandered the funds of a Sunday school class of which he was the treasurer, signed his teacher's name to a check, operated more and more extensively in false signatures until he was guilty to the extent of several hundred dollars. Two sisters, aged 17 and 12 respectively, were fond of finery, and began to steal articles of jewelry, ribbons, etc., from friends. Then they took to shop-lifting, and operated in several stores for some months before they were detected. When arrested they had secreted in different places dress-patterns, pieces of silk, gloves, capes, jackets, table linen, thread, shoes, hats, diamond rings, etc. L., a girl of 18, well connected, but too fond of dress for her means, entered a flat by means of false keys she had secured, and stole a gold watch, a pearl ring, two pairs of gold earrings, two plain gold rings, and $75 in cash. With the money she purchased a silk sacque, a silk skirt and a pair of shoes, and then arrayed herself in all her stolen finery and started forth for a good time. These cases of theft, like all other forms of crime, are much too complex to explain upon any single hypothesis. But that defective development of the moral sense, and particularly of the sense of property rights, as well as a lack of the inhibitory impulses normally present in individuals at such periods of life, are central causes, cannot be doubted.

(c) *Gluttony* and *drunkenness* represent the persistence of the undiscriminating food appetite found in animals, savages and young children. Animals eat to repletion, and are often greedy to

a gluttonous extent. The ravenous appetites of certain of the Carnivora, and the omnivorous, perfectly insatiable appetites of the pigs are illustrative. Savages are enormous eaters, as is shown by the great development of their alimentary systems as well as by the amount of food they can consume. Their teeth and the bones and muscles of their jaws are larger and stronger than is the case among civilized peoples. Their stomachs are large and protuberant. The Kamschadales have a hanging belly. The Bushmen, according to Barrow, have uncommonly protuberant stomachs. Schweinfurth describes the Akkas as having "large, bloated bellies, and short, bandy legs." The children of savages are peculiarly developed in this respect. Those of the Veddahs and African Arabs have protuberant, pendant bellies. Galton says of the Damara children that "all have dreadfully swelled stomachs." The quantity of food eaten also bears a strict relation to the generous alimentary provisions for it. "Wrangle says each of the Yakuts ate in a day six times as many fish as he could eat." "Cochrane describes a five-year-old child of this race as devouring three candles, several pounds of sour frozen butter, and a large piece of yellow soap; and adds: 'I have repeatedly seen a Yakut or a Tongouse devour forty pounds of meat in a day.'" "Of the Comanches, Schoolcraft says: 'After long abstinence they eat voraciously and without apparent inconvenience.'" "Thompson says of the Bushmen that they have 'powers of stomach similar to the beasts of prey, both in voracity and in supporting hunger.'"[1] The children of civilized peoples have appetites very similar to those described. They eat to repletion and undiscriminatingly, and it is well known that this voracity of appetite accounts for many of the diseases peculiar to childhood.

Among adult men and women of civilized communities, the tendency to gormandize is not uncommon. "When we know how little food is really required to sustain life, we may the more readily surmise how very much more food is taken by most persons than can ever be applied usefully towards sustainment. We have no compunction in asserting that while fasting enthusiasts are subjecting themselves to considerable danger from abstinence, hundreds of thousands of persons are subjecting themselves to a slower but equal danger from excesses of foods and drinks. These keep up their experiment, and, with every vessel in their bodies strained to repletion and seriously overtaxed, continue to replete and strain the more."[2] Occasionally, individuals so distinguish themselves for the amount of food devoured that their cases are recorded in his-

[1] Spencer: *Principles of Sociology*, Vol. I, p. 45.
[2] Richardson, in *Tuke's Dict. of Psy. Med.*, p. 773.

tory. A Tartar courier is described by Vambéry as eating at one time a large skinful of raisins and a middle-sized pig, leaving nothing but the bristles and a few of the larger bones. At another time, within fifty hours, he ate a goat and two kids, together with a bag of dried figs and a quantity of koumiss. An Englishman, living in Yorkshire, exhibited himself as a professional glutton. He could eat a dozen pigeons, feathers, bones and all, and swallow trout and other fish alive. On one occasion he won a wager by devouring within two hours all the edibles, including half a cheese and a large quantity of pickles, on a table that had been set for eight persons.[1] As we know from history, some of the Roman emperors during the decadence of the empire were addicted to indescribable excesses of appetite. The feasts of Appricius lasted for a whole day, and sometimes for two days. Guests were restricted to recesses of ten minutes, and were obliged to eat something of everything placed before them and to drink a prescribed amount of wine. Vitellius ate three brace of peacocks at one sitting, prolonged his banquets hour after hour without intermission, and spent the revenues of an entire province upon one such debauch. Cicero describes the scene after a Roman banquet as resembling a battlefield. In the reigns of Caligula, Domitian, and Heliogabalus, such occasions were the financial ruin of the wealthiest patricians, vast fortunes being squandered in providing delicacies from all parts of the empire. The gormandizing instincts of these Roman epicures have their modern analogues in aristocratic circles in Europe and America. The luxurious catering establishments, the elaborate *menus* served at fashionable clubs, and the ostentatious expenditure of tens of thousands of dollars upon the dinners that grace various social functions, are facts so patent in metropolitan communities as to need no more than mention. Indeed, it may be laid down as a law that wherever great wealth and luxury exist side by side with inferior intelligence the first sign of decadence appears in the resurgence of the primitive instinct of sense-repletion, as illustrated in some form of gluttony.

Drunkeness is closely related to gluttony, and almost invariably accompanies it. This is as true historically as it is from the standpoint of current social customs. Both are the derivatives of a very primitive and voracious appetite. Wherever savages have been able to invent intoxicating drinks, they have used them to excess; and wherever they have secured the more intoxicating liquors of civilization, they have drunk themselves to extinction. The savage is the drunkard par excellence, and the appetite among civilized peoples that craves

[1] Oswald: *Dietetic Curiosities*. Popular Sci. Mo. Vol. XIV, p. 730.

intoxicants must be regarded as primarily a gross animal appetite, rendered persistent through an arrest of psychical development and given direction by the environments of civilization. This is not to deny that drunkenness is immediately induced by other causes, as in the case of mental affections, which antedate the drink habit. But the general character of the appetite for drink, combined with the physical and psychical attributes of those who become the typical drunkards of civilized communities, indicate a diathesis springing from the same tap root as gluttony. And even in the case of those who take to drink through antecedent disease, the question as to why their disease should take the form of drunkenness remains to be answered. We have got beyond the time when such a phenomenon can be explained as mere chance. And to say that, under such circumstances as those attending dipsomania, a man or woman takes to drink because of a craving for stimulants, explains nothing. It is certainly more rational to suppose that in drunkenness, as in most of the other vices that appear to come into prominence as concomitants of mental disease, we have to do with a law of evolution. Why not regard such vices as an expression of the fundamental diathesis of the individual, freed from the inhibitory restraints of higher levels of consciousness that are now in process of dissolution?

(d) While the causes that produce *unchastity* are complex, it is not improbable that here, too, we have to take into account arrest of psychical development. Organic life fundamentally unfolds itself in men as it does in animals. The sexual system is elaborated with the same care, and makes its demands in accordance with the same general laws in one case as in the other. It is only as intelligence and morality react upon the instincts which express an organic need, that men come to follow sexual laws at all different from those followed by animals. In other words, sex-differentiations in men are essentially psychical. Now, if for any reason psychical differentiation does not take place, and if, as is usually the case, organic sex-development proceeds, it necessarily results that a sexual animal is produced without the psychical concomitants of a sexual man. Upon such an hypothesis we would expect to find in civilized life every form of sexual manifestation, from the unrestrained appetite of animals and the scarcely less unrestrained lust of savages up to the subdued and thoroughly controlled sexuality of the highest types of men and women. And this is what we do find. In proportion to the level of psychical development attained by each individual is the primitive sex-diathesis subordinated. And in proportion as development has been interfered with does the primitive sex-diathesis assert itself. This does not imply that there is any less perfectly developed sexual

system or any less organic need in the highest creature than in the lowest one. It implies merely that sexuality in civilized communities is now conditioned by chaste personal conduct and by obedience to social customs and laws.

Of the arrests in sexual development among civilized people the one most suggestive of animal sexuality is masturbation. This is essentially a phenomenon of childhood and early adolescence, and is an expression of an awakening sex feeling unduly stimulated, perhaps, by environments, and seeking its gratification by any means whatsoever. The young of many animals show an altogether similar disposition. Young dogs, pigs, cattle and horses evince their first sex yearnings by sporting with one another, regardless of sex. Many of the males, at least, masturbate constantly. This phenomenon, as seen in children, is far more common than is generally acknowledged. The taboo that is placed upon such subjects by parents and educators has hitherto relegated them to the private speculations and discussions of children themselves and to the purveyors of quack literature. As a result there is probably no subject upon which there is greater ignorance. An illustration is found in the popular opinion that children will not acquire this habit except by example, and by the opinion prevalent among at least some medical men that the habit is usually the sign of disease. The obvious conclusion from such opinions would be that if a child is healthy and has no evil associates it will run no risk of self-pollution. Both of these opinions have truth in them, and the precautions they suggest are salutary. But it is certain that children may form such habits, exactly as the young dogs and pigs do, in trying to gratify instincts that are deeper than imitation or any conditions produced by disease.[1]

Cases of masturbation among boys and girls of 5, 6, 7 and 8 years are relatively common. To explain the beginnings of sex gratification in such young children upon the hypothesis of arrested development is of course impossible and unnecessary. They have not yet reached the age when we can speak of arrested sexual development at all. They are probably manifesting instincts, somewhat precociously, it may be, but nevertheless innocently, just as young animals manifest them. But, suppose that this naïve animal tendency persists into mature years, either through the ignorance of the child or its parents, or through an arrest of psychical development induced by the habit itself or by some other means, and we have just the condition met with in the perverse sexuality of thousands of adolescents, as well as in mature men and women. It is to such

[1] See report on masturbation among infants, by Dr. Townsend, in *Archives of Pediatrics*, Nov., 1896.

that the term "arrested development" may be legitimately applied.

Most reformatories, prisons, and insane asylums afford illustrations of this primitive animal sexuality, while society everywhere contains individuals who sustain normal relations to it, yet whose lives are dominated by a passion that daily jeopardizes their own well-being and often that of individuals about them. A few cases will suffice to illustrate: C., a man aged 36, born of well-to-do and healthy parents; a strong, active, but sexually precocious child; began to masturbate before he was 8 years old and continued the habit regularly until he was 17, when he learned its consequences and tried to stop it; tore himself away from his old associations, educated himself and became a successful teacher, meanwhile struggling against his appetite; made a silent but heroic fight for ten years; then gave up in despair, and is now half imbecile in character, alternating between moods of stupor and suicidal mania. S., aged 26 at the time of his death; born of well-to-do and respectable parents; learned to masturbate and to be incontinent with little girls while he was yet in graded schools; had precocious and strong sexual appetite, which within a few years completely mastered him; tried frequently to reform himself; gave himself a college and medical education, meanwhile adding associations with abandoned women to his solitary vice; located in a large city, and kept mistresses one after another; gave up the struggle with his sexual appetite at 26, and committed suicide. A., aged 29; born of wealthy and cultivated parents; had good educational and social advantages; was a strong, healthy boy, but became impure in the early teens and from that time on was more and more addicted to incontinence, both with girls and in solitary vice; began to frequent houses of prostitution at 22 and practiced frightful excesses; at 25 kept an extremely depraved mistress who acquired great influence over him and from whom he submitted to oral manipulation; spent all his income upon this mistress and forged checks for large sums of money with which to gratify her vanity; kept up such practices until he was brought to justice. G., aged 25 at the time of her death, became unchaste when 9 or 10 years old, and thereafter was more or less constantly lewd among her schoolmates; at 17 began to prostitute herself under cover of pretended visits to neighboring cities, and dressed flashily; at 22 married an indolent but fairly respectable man in her native town, and tried to restore herself to a social position, meanwhile, however, keeping up clandestine relations with different men; at 25, died from syphilis. M., a woman of 23, had the reputation of masturbating and teaching the habit to other girls at the age of 8 years; became notoriously

unchaste with boys at 12, and grew to be the terror of the neighborhood; bore an illegitimate child at 16, and thereafter alternated between a life of prostitution in the cities and indolent enjoyment of her income in the country home of her relatives.

With this class of sexual offenders belong many of the common prostitutes. From answers received from competent authorities in the various great metropolitan centers, Dr. Wood Hutchinson concludes that 5.6 per cent. of all the prostitutes are drawn into their course of life by sexual appetite alone, most of the others being the victims of vanity and idleness. This per cent. is small, but it indicates the presence in society of a class of women who depart radically from the civilized type. With this class also belong those youth and men, half imbecile in character, who hang about the parks and alleys of the cities, gratifying a prurient curiosity with little girls and sometimes insulting women with indecent remarks or with exposure of person.

Not so close to the animal type of sexuality, but rather illustrating the persistence of savage instincts, are the rapists. Among savage peoples, force is often employed in sexual union. Marriage by capture is common in some races, and in most races women cannot leave the neighborhood of their own huts without due precautions. Among some of the American Indians a woman found outside of the camp belongs to any man that can capture her. It is not strange, therefore, that the crime of rape should be so common among our negro and Indian populations. According to the United States census for 1890, there were confined in the various prisons 814 white rapists, 569 negro rapists, and 8 Indian rapists. Upon the basis of 1,000,000 inhabitants of each of these divisions of the population, the ratios are 14.2, 23.4, and 24.8, respectively. The total number of persons, including juvenile offenders, that were in prison for rape in 1890 was 1,408. Add to these 2,809 persons confined at the same time for incest, crimes against nature, fornication, etc., and we have a total of 4,217 persons in the United States that were guilty of grave sexual offenses. This is 4.3 per cent. of all the delinquents in confinement, and represents sixty-seven individuals to every million of the population. The fact that in a nation of 62,623,250 people 4,217 persons are in confinement for acts of savage and bestial sexuality that have been detected, proves the persistence of a very primitive sex diathesis in the midst of civilization.

(e) In *assault* upon the person there is involved a purpose to injure or kill a fellow-creature. This may proceed from the instinct of self-defense or from malevolent passions excited by

other causes. In any case, however, the man who lays violent hands upon another man aims, unconsciously or consciously, at the destruction of life. Such an act reveals the animal and sub-human instincts that were once economical, but are now self-destructive as well as anti-social. "Whoso sheddeth man's blood, by man shall his blood be shed," expresses the law that has governed society's treatment of the assaulter from the time when the family avenged the injury or death of a member to the present, when the power of avenging rests with the State. So long and so carefully has society guarded the life of its members that the elimination of the instinct to kill has perhaps proceeded farther than that of any other instinct. Even children respect life, normally, and except in their tendencies to be cruel in teasing or domineering over playmates, there is nothing to indicate a passion strong enough to seek gratification in murder. Yet individuals exist in every community that are probably capable of shooting, stabbing or poisoning a fellow-being. In most cases this disposition comes to light only when rage, hate, or revenge dominate the mind, and, under such circumstances, the question may well be raised whether most persons do not glimpse the possibility of murder. In some cases, however, the disposition to kill is but little, if at all, concealed, and manifests itself in every degree of insanity, from fighting with fists and clubs to deliberate destruction of life.

The willingness to kill a man or to commit any assault upon him that involves the possibility of his death, is a disposition so alien to the altruistic spirit of civilization that it can be explained only on the hypothesis of an imperfectly developed human being. From some cause the psychical qualities of the animal or sub-human ancestors have persisted just as they have persisted in the idiot. This is illustrated in such well-known cases as Jesse Pomeroy and the murderer Holmes, where the most inhuman crimes were committed merely incidentally to the pursuit of the ends of self-realization. It is just as in the case of the tiger that drags to the earth an antelope, gorges itself upon its flesh, and then passes on indifferently to its lair; or in the case of the savage that shoots another savage through the heart, possesses himself of his hunting equipments, and proceeds in further quest of game or plunder. It is illustrated in the case of such burglars as Kelly, who went into a bank with a bag to carry away the booty, and with a slung-shot and razor to kill any one who might get in his way. When the aged cashier made the resistance that was expected, Kelly merely did what he was prepared to do, felled him to the floor with the slung-shot and then cut his throat. It is illustrated in such criminals from passion as Madame DuTilly, who threw vitriol in the face of a rival; of Madame Darn, who stabbed her

husband to escape his brutality; and of Marie Barberi, who killed her lover because he had seduced her and then treated her with scorn. Such and similar cases swell the total of homicides to relatively vast proportions in the most highly civilized countries. According to the official census for 1890 there were confined in the prisons of the United States 7,351 persons convicted of homicide, or 89 to every 1,000,000 of the population. The ratio of the different elements of the population guilty of this kind of crime are quite as significant as in the case of rape, affording an incidental support to the hypothesis advanced in this study. Thus, the ratio per million of white persons was 77.2; of negroes, 112.8; of Chinese, 230.9; and of Indians, 285.7.

§ 5. Hypertrophy and Disease Due to Arrest.

The persistence of regressive structures and qualities is sometimes accompanied by hypertrophy and disease. The *vermiform appendix*, which is usually about 8½ cms. in length may grow to a length of 20 to 23 cms. It is subject to pathological changes and is the seat of the fatal disease known as "appendicitis." The *thyroid gland* is normally a regressive organ. In the new-born infant its proportion to the weight of the body is as 1 : 240 or 400; at the end of the first three weeks, it is as 1 : 1160; and in the adult, it becomes as 1 : 1800. It is sometimes much enlarged, this tendency appearing to increase under certain pathological conditions. Thus, in monstrosities, it is frequently found to be enlarged, according to the descriptions given by Otto.[1] It is also associated with cretinism. In advanced life it is liable to become indurated, and frequently contains earthy deposits. Its vesicles also attain a very large size. Its most characteristic disease, however, is goitre, when the neck may not only become greatly deformed, but when also the goitrous growth may become so great as to hang down half the length of the body. The persistence of the *cervical ribs* is frequently accompanied by aneurism of the subclavian, and the obliteration of the arteries supplying the upper limbs. In some cases there are neuralgic pains in the forearms and fingers and other troublesome symptoms, necessitating the removal of the abnormal ribs. The persistence of the didelphous form of the uterus is sometimes of such an exaggerated type that there are two distinct organs, and the woman becomes not only subject to such disorders as may arise from a condition so anomalous, but also unfitted for her functions as a woman. A case is described by Ameiss[2] in which a complete septum half a centimeter in thickness extended throughout the vagina;

[1] *Monstrorum Sexcentorum Descriptio Anatomica.*
[2] *American Journal of Obstetrics*, Vol. III (1896).

while the uteri were entirely separated, the left one being 5 cms. deep and retroverting towards the left, and the right one being 4 cms. deep and retroverting towards the right.

These exaggerated types of rudimentary structures shade off into the anomalous organisms called "monsters." Probably most of the latter illustrate in some detail the persistence of conditions peculiar to lower developmental stages. Monsters are now considered to be due to arrested development, so that their connection with rudimentary organs and the general law of regression becomes evident. Thus Fisher[1] says: "It has been observed by eminent embryologists that the transient forms of the human embryo, in its several stages of evolution, bear a striking resemblance to the persistent types of the lower orders of animals; hence, the human malformations which result from arrested development often acquire the appearance of brutes, while those occurring in animals, for the most part, have the forms of beings still lower in the scale." The general resemblance of human monsters to lower animals was observed long before science came into existence, and all kinds of superstitious beliefs were entertained concerning it. Thus, it was thought that such monsters were the products of unions between women and brutes or between women and devils. The belief still exists that they are the result of "impressions" received by the mother during pregnancy. Such resemblances are certainly met with, as any one must own who has examined the specimens in a well-equipped museum of pathological anatomy. Medical literature records occasional instances in which these resemblances occur. Thus, Lambeth, in the *Weekly Medical Review*, of St. Louis, describes the case of a male child "whose every feature resembled that of a much excited but harmless cow." Hord, in the *Chicago Medical Journal and Examiner*,[2] describes a case of monstrosity in the form of "a child with a dog's head." Hamilton, in the *Northwest Medical and Surgical Journal*,[3] gives an account of a "monster with a head resembling a dog's." Gregory, in the *Philosophical Transactions* (London),[4] tells of a monstrous human fœtus "resembling a hooded monkey."

While fancy has played its part in the detection of brute-resemblances, there is no doubt a residuum of truth in the belief that these resemblances are real. If every human embryo does indeed recapitulate the stages of phylogenetic development, and if monsters are due to an arrest in embryonic

[1] *Reference Handbook of the Medical Sciences*, Vol. VII, pp. 1–28.
[2] Vol. XLVIII, p. 246.
[3] Vol. V, p. 455.
[4] Vol. VIII, p. 314 and Vol. IX, p. 316.

development, it is entirely reasonable that certain brute resemblances should now and then come to light so as to attract even general notice. When the anatomy of such monsters is examined more in detail, it is found that the superficial resemblance is but an expression of structural conditions actually present. About the beginning of the second month of fœtal life, four papillary prominences or embryonic buds appear. These are the beginnings of the arms and legs. Now if the development of the limbs is arrested at this time, various forms of *Amelia* occur that recall lower stages of development. The arms and legs may be short and set at such an angle as to resemble closely the flippers of a seal. The toes and fingers may be webbed like those of various animals. The limbs may appear to develop after the Simian type, the arms being relatively longer and the legs and feet showing an exaggeration of the usual structural resemblances to those of apes. Previous to the end of the third week the head of the embryo is not discernible, being undifferentiated from the body. After this period, during the fourth week, it develops so rapidly as to be equal in bulk to the trunk. *Acephaly* would therefore occur if an arrest of development took place during this period; while every gradation of incomplete cephalic development may result from subsequent arrests. Here is suggested the rationale of all those brainless and half-brainless monsters, from the acephalous type, that is not viable, to the microcephalic idiot that lives and becomes a burden upon society. It is not unreasonable to suppose that all of them represent brute stages of development, and that their strange resemblances to animals is not accidental but inevitable, as an expression of law. The human face, like the head, passes through a series of developmental stages, arrest at any one of which may perpetuate brute elements of physiognomy. During the sixth week, the anterior portion of the pharynx presents a large opening bounded by the facial arches. This opening is afterwards partially closed as the different parts of the face are formed. Arrest of development produces the facial fissures, such as single and double hare-lip, cleft palate, etc. The jaws, mouth, and especially the nose in monsters frequently perpetuate the animal types. All of the structures of the reproductive system in monsters may take on forms suggestive of those found in animals as permanent organs. Thus double uterus and vagina, hermaphroditism, hypertrophied external genitals, and other anomalies are frequently met with.

Whatever one may think of these monstrous organisms that appear here and there in human life, he is bound to suppose that they are produced in accordance with creative law. Goethe has said that it is in her monstrosities that Nature reveals her

laws. We must regard them as illustrations of the extreme types of organic retrogression. The forces of life are so far spent that elaboration cannot longer proceed normally, and all the heritage of organic debris becomes persistent and diseased through the failure of creative energy to eliminate it. In other words, the hypothetical condition described by Weissmann[1] in his statement of the rationale of rudimentary organs has been realized: "If Nature were not able to effect the disappearance of superfluous organs the transformation of species would have been well-nigh impossible, for the existing parts which had become superfluous would have been in the way of other active parts, and would have hindered their development. Indeed, had all parts which the ancestors possessed been necessarily retained, an abnormal animal would at last have been produced—a monster no longer capable of living."

The law that thus reveals itself in pathological anatomy has its application also in the field of morbid psychology. The animal and sub-human qualities of the human soul that we have found to be persistent under conditions of arrested development, are liable to perversions of every kind. There are exaggerated or diseased appetites and passions that produce monsters of gluttony, lust, cruelty, hatred, and egoism in general. Such are best illustrated in insanity. The belief in a type of insanity that is related essentially to the moral nature has been very generally held. Pritchard, Georget, Pinel, and Esquirol believed that there is a moral derangement without appreciable intellectual error or delusion. Esquirol says; "There are madmen in whom it is difficult to discover a trace of hallucination, but there are *none* in whom the passions and moral affections are not disordered, perverted, or destroyed." In forty years' experience in the Salpêtrière and Charenton, and in his private practice, Esquirol states that he met no exception to this rule. Pritchard defined "moral insanity" as "a madness consisting in a morbid perversiou of the natural feelings, affections, inclinations, temper, habits, moral dispositions and natural impulses, without any remarkable disorder or defect of the intellect, or knowing and reasoning faculties, and particularly without any insane delusions or hallucinations." Carpenter says: "Moral insanity may, and frequently does, exist without any disorder of the intellectual powers, or any delusion whatever." Clouston says:[2] "There are many cases where the moral defects are the disease, the intellectual defects, if present, being so slight that they would not

[1] Quoted by Wiedersheim: *Structure of Man*, p. 212.
[2] Mental Diseases, p. 350.

have constituted insanity or have interfered with the patient's work or position in the world."

How, then, may moral insanity be explained? If it occurs in those individuals who have shown a progressive evolution of immorality, it cannot but indicate the persistence of rudimentary qualities exaggerated into criminal and then into insane proportions by arrest of development and by the pathological conditions such an arrest of development might induce. The following case cited by Clouston will illustrate:—A boy, F. I. "No one who knew him ever believed a word he said. He stole, he had small affective power, and he never seemed to see why anybody should be offended at acts of immorality or dishonor, though carefully and religiously brought up. In after life, he turned out a selfish and negatively immoral man. He never paid any debt that he could help, and he borrowed from every one he could. He treated his relations badly. He on several occasions did public acts that might have brought him under the cognizance of the criminal law." Clouston further says: "Such cases are the bane and disgrace of their relations. Nothing can be made of most of them morally, any more than a genetous idiot can be converted into an active minded man. Wrong is right to them; they prefer lies to truth, immorality to morality." On the other hand, when moral insanity has not been preceded by immorality, so far as is known, but rather seems to have induced the latter, the explanation may be difficult. Doubtless, some such cases are the results of morbid processes quite remote from the vices and crimes they occasion. Yet, even here, why do these vices and crimes come to the front? Why should not an insane person become transformed into a pure and exalted type of manhood and womanhood, rather than into a filthy, licentious or murderous type, as is so often the case? Why have such creatures won, and doubtless deserved the reputaion of being *madmen?* It must surely be that the worst elements of human nature are always ready to assert themselves the moment reason is dethroned, or else a man's becoming insane might once in a while improve his character. Must not the vices and crimes of the insane mind spring from the same instincts as do vices and crimes generally? Must we not suppose that in such cases the fundamental qualities of the animal psyche come to the fore because they are the oldest and are mediated by lower levels of consciousness? If insanity is to be regarded as psychical retrogression, should we not expect that the more radical the process of disintegration in consciousness, the more active would be those elements of mind that minister to organic needs? Hence, the instincts that have to do with food, sex, and

self-preservation generally, would become dominant, and man, with his reason destroyed, would become literally a brute.

1. *Dipsomania* illustrates the diseased form of the drink appetite. Clouston defines it as "a morbid, uncontrollable craving for alcohol and other stimulants." "The morbid craving for alcohol is common, and so intense that men who labor under it will gratify it without regard to their health, their wealth, their honor, their wives, their children, or their soul's salvation." Such cases are common in every civilized community. Sometimes they are confined in asylums; but often they are members of society, propagating offspring, assisting in the government of towns, cities and nations, and not infrequently holding offices of responsibility. F., a man fifty years old, began drinking in his youth, but not to excess; was well connected, talented, and secured an excellent education; was admitted to the bar and practiced law for a number of years with great success; meanwhile, he drank harder and harder, and finally began to be irregular in his work and unreliable in his dealings; at last lost his practice, became a burden upon his family, and was sent to a "gold-cure" establishment; returned home "cured" and renewed his practice of law with prospects of success; took to drinking again, however, sank lower and lower, and is at present in an inebriate asylum. S., a laboring man, was at one time a skilled and reliable workman; took to drink, became irregular in his habits, and lost his position; went to still greater excesses, had delirium tremens, lay in drunken stupors for hours and was finally sent to an asylum; was released after a time as sufficiently reformed, but soon began drinking to excess, and ended his life by consuming a large amount of raw alcohol. Such cases could be multiplied indefinitely. Most of them are the same story of moderate drinking, excessive drinking, attempts at reform, relapses, greater excesses, delirium tremens, a prolonged debauch, death.

2. *Kleptomania* illustrates the diseased form of theft. It is an uncontrollable impulse to take whatever strikes the fancy, and is met with among imbeciles, general paralytics, and other classes of the insane. Frequently, however, it is found among people outside of the asylums, women, and especially women of the upper classes, being subject to impulses of this kind. It is the opinion of criminologists that the sense of property in all women is weak, which fact may account for the greater prevalence of kleptomania among them than among men. Their love of dress, and the temptation thrown in their way in the stores and shops to pick up little articles of finery, may also have its influence. An inspector of the Bon Marché, in Paris, is of the opinion that twenty-five per cent. of the shoplifters are habitual offenders who rob whenever they can,

twenty-five per cent. are impelled to the act by want, and fifty per cent. are kleptomaniacs of good social standing and wealth, who simply appropriate pretty things from the counters because they can't resist the temptation to do so.[1] Almost every community has its kleptomaniac among the wealthier class, enjoying immunity from prosecution because of the prominence of the family, or the respect and pity felt for her husband. Mrs. F. was well known throughout a town of 10,000 inhabitants as a shop-lifter and pilferer from every house she entered. Her husband had an understanding with the proprietors of stores that they present bills to him for any articles they knew his wife to take. Similar arrangements existed by which neighbors and others could recover their missing valuables by going to the house. In a city of 100,000 inhabitants, the chief of police was at one time informed that flowers were being systematically stolen from the graves in the principal cemetery. He set officers to work at the case, and discovered that the offender was a prominent woman of the city, who was an all-round shop-lifter and under constant surveillance. She had never been prosecuted, for reasons similar to those given in the case of Mrs. F. The recent case of Mrs. C., who was apprehended in London when she and her husband were just on the point of sailing for their home in the United States, excited international interest. This woman was wealthy and extremely well connected. Yet she had stolen thousands of dollars' worth of tid-bits of every kind as she travelled about from place to place. Even the silver and table linen of hotels had not escaped her desires. She was prosecuted and convicted, but was afterward pronounced irresponsible by high medical authorities and was released from custody to return home.

3. Hypertrophy of the sexual instinct manifests itself in a variety of ways. Thus, in *satyriasis* and *nymphomania*, there is an uncontrollable impulse to satisfy the sexual appetite without regard to circumstances. The desire may be so intense as to lead to murder if opposition is offered to the person. Doubtless many of the rapes, accompanied with the killing of the victims, that occasionally occur in every large community, are committed by this class of individuals. In *Sadism* there is a morbid inclination towards the opposite sex, accompanied with a desire to inflict pain and injury. This is probably but an exaggeration of the rudimentary animal or savage impulse to conquer the woman in connection with sexual union. Thus lust comes to be associated with the most brutal acts, such as beating, cutting, and mutilation. Such crimes as those of "Jack the Ripper," where the murdered women were always mutilated in a

[1] Lombroso: *The Female Offender* (Morrison's Translation), p. 207.

particular fashion, are probably the work of men thus sexually diseased. In *sexual fetichism*, some part of the female body, as the neck, hand or ankle, or some article of dress, or even the natural odor of the body of the female or the perfume she uses, is sufficient to excite voluptuous sensations and produce involuntary pollutions. In *masochism*, *pederasty*, *sodomy*, "*Lesbian love*," etc., there are various gross inversions of the sexual instinct, leading to vices that are unspeakably loathsome. Most of these sexual aberrations are reducible to a primarily strong sexual appetite, rendered more intense by gratification or disease, and given its particular direction by the circumstances surrounding the individual. That they are far from rare in the most highly civilized countries past and current history conclusively proves. Indeed, it is in man's sexual nature that the grossest perversions of character are wrought. The history of moral pathology in the individual and in society would be largely the history of abnormal sex-relations.

4. *Homicidal mania* illustrates the pathological form of all those fundamental egoistic instincts that center in love of power over others,—hatred, revenge, envy, jealousy, etc. There is present an uncontrollable impulse to lay violent hands upon or kill persons indiscriminately, and this impulse is a common symptom in some forms of mental disease. Thus, frequently in epilepsy the patient believes himself to be injured or persecuted by others, and obeys the natural animal impulse to rid himself of his supposed enemies. The murderous impulse manifests itself in the insane forms of *jealousy*, especially in women. An English woman believed that a certain doctor would marry her if his wife were out of the way. She therefore became madly jealous of her rival, and succeeded in putting poison into some cream chocolates that she knew the latter would eat. In melancholia the patient sometimes harbors suspicions and broods over supposed wrongs until he becomes possessed of an impulse to kill those about him. Children occasionally show homicidal tendencies, either as a result of antecedent brain disease, or from a morbidly imitative disposition that takes its cue from accounts of murders, sensational stories, etc. Delirium tremens, also, sometimes takes the form of an impulse to kill. In short, any of the malevolent passions which incline a person to do his enemy injury, but which in rational minds are usually controlled, may assert themselves in an effort to injure or kill when the mind is deranged.

5. Besides these more typical exaggerations of instinctive tendencies found in mental disease there are numerous others illustrating the same law of regression. Sometimes there are perverted food-appetites that find gratification in eccentric and even monstrous methods. We know from the Hebrew Scriptures

how the mad Nebuchadnezzar "did eat grass as oxen, and his body was wet with the dews of heaven, till his hair was grown like eagles' feathers and his nails like birds' claws." Filth of all kinds may be eaten in certain forms of insanity, while cases have been known in which cannibalism occurred. Probably it would be scientific, as well as charitable, to suppose that the starving men who have been known to eat their comrades were, at least, temporarily deranged. Destructive tendencies frequently appear, *pyromania*, excessive vanity, as in *delusions of grandeur;* morbid suspicions, as in the *mania of persecution;* and, in fact, innumerable exaggerations of traits that lurk in every man's and woman's character, but which are ordinarily repressed and concealed by the higher intellectual and emotional attributes. In all such cases we must suppose that one of two general forces is at work; either the weakened condition of the mind has become the occasion for the outbreak of otherwise unsuspected appetites and passions, or the appetites and passions have gradually asserted a complete dominion over the powers of the mind that usually inhibit and repress them. In the language of Clouston, "The driver may be so weak that he cannot control well-broken horses, or the horses may be so hard-mouthed that no driver can pull them up."

The following explanation given by Clouston of what he calls *Animal and Organic Impulse* is confirmatory of the point of view taken in this section: "Under this term I include all the uncontrollable impulses towards sexual intercourse, masturbation, sodomy, rape on children, bestiality, etc. The perverted instincts, appetites and feelings shown in urine drinking, eating stones, rags, clay, nails, etc., come under this heading, too. *There are few cases of mental disease where some appetite or instinct is not in some degree perverted or paralyzed. But there are cases where such things are so prominent as to constitute disease.*[1] I have a patient who assures me that his desire to masturbate is an irresistible craving which he has no power to control. Here is a girl who rubs her thighs together to produce sexual excitement the moment she sees a man. Here is a case of nymphomania, who rushes towards any man she sees, and can scarcely be held by two attendants. I believe there are cases where there is an irresistible impulse towards sodomy and incest. Many of the men who commit rape on children are insane. I lately had to give evidence at the Carlisle Assizes about the insanity of a medical man who had tried to commit rape on three children under age in succession. No doubt he had the delusion that God had in some occult way revealed to him that he should beget a male child, and had sent the little girls to

[1] Italics mine.

him for this purpose; but he was practicing his profession up to the commission of the act. I have referred to the case of the young woman who had an impulse to eat clay and dirt every time she menstruated. She could not help it, and had no such tendency between. A shoemaker patient in the Prestwich asylum swallowed a few shoe nails every day, and, which was strange, was none the worse. There is an infinite variety of such impulses."[1]

§ 6. Prepotent Retrogression.

The different organic and psychical elements retrograde concomitantly, and the extent of the retrogression is determined by the grade or level of the principal element involved. An illustration drawn from the nervous system will, perhaps, serve to make this part of the discussion clearer. According to the segmental view of the spinal axis we may regard it as made up of three grades of meristic levels. First, there is a series of levels below the medulla, in which the organs represented by each segment have a certain independence, so far as nervous function is concerned. These sub-medullary levels are concerned only with the lower portions of the body. Next, there is the series of levels constituting the medulla, which, by the intermediation of centripetal fibres are brought into relation with the lower part of the body and its limbs, with the upper part of the body and its limbs, with many of the visceral structures, and with the organs of special sense. Finally, there is the series of levels constituting the cerebellum and cerebrum. These contain such a vast number of highly differentiated structures that they are not only brought into relation with every part of the nervous system, but also of themselves constitute that infinitely complex mechanism that has for its peculiar office the mediation of psychical activity. Now, if a variation should occur in one of the sub-medullary levels it would affect only those organs dependent upon that particular segment. If the variation should occur in the medullary levels, however, it might affect organs in the lower part of the body, in the upper part of the body, in the viscera, or in the structures concerned with special sensation. Finally, if the variation should occur in the brain levels themselves it might involve organs of any part of the body or brain.

Teratology is also suggestive in this connection. In human "monsters" there seems to be some relation between the number of anomalies and the gravity of the primary defect. The illustrations in teratological works such as St. Hilaire's, Forster's and Otto's, as well as the specimens in pathological

[1] *Mental Diseases*, p. 331.

museums, impress one with the large number of anomalies that appear in the worst types of monstrosity, such as acephaly, hemicephaly, etc. The detailed descriptions given by Otto[1] of two hundred human "monsters" have been examined with a view of determining whether such a general impression is correct. The cases examined fall into three groups: 1—those in which the primary affection was cephalic; 2—those in which the primary affection was visceral; and 3—those in which the primary affection was mainly in the limbs. The number of anomalies in each case was counted, omitting the primary affection. The following is the number of cases falling in each group, together with the average number of anomalies: 1—Brain, 70 cases, with an average of 7.3 anomalies; 2—Viscera, 56 cases, with an average of 4 anomalies; and 3—Limbs, 76 cases, with an average of 3.8 anomalies. Some additional weight is lent to these facts by the conclusions of criminal anthropologists and alienists as to the relation between psychical anomalies and the extent of the degenerative process in idiots, lunatics, and other defectives.

On the neurological side, the Hughlings-Jackson[2] theory of brain levels supports the law here referred to. This theory grew out of an attempt to explain the mental phenomena of epilepsy, insanity, etc. It supposes three levels of brain development, which mediate respectively three general classes of psychical phenomena. The *lowest level*, which includes the gray matter of the spinal cord and its extension into the brain proper as far as the oculo-motor nucleus, mediates actions of an organized or habitual character, such as certain movements of the limbs, the reflex visceral activities, swallowing, respiration, peristalsis of the intestines, vaso-motor and cardiac action, and the reflex movements of the pupils. This level of mind, therefore, has to do with the vegetative functions of the human organism. It belongs to the great sphere of the sub-conscious mind. The *middle level*, which includes the motor areas of the brain found in the two central convolutions bounding the fissure of Rolando and in other contiguous portions more or less indefinitely determined, mediate the various voluntary movements, such as those of the tongue, lips, arms, legs, and trunk. The *highest level* embraces the præcentral and occipital regions of the brain and is pre-eminently the organ of the self-conscious mind. None of these levels is altogether independent of the others. The nervous centers of the lowest level represent impressions and movements of all parts of the body most nearly directly, and are first in order of development from an evolu-

[1] *Monstrorum Sexcentorum Descriptio Anatomica.*
[2] *Journal of Medical Science*, Vol. XXXIV, p. 359.

tionary standpoint. The centers of the middle level re-represent what has been received from the lowest level, and are, in a sense, the outgrowth of the latter, while the centers of the highest level re-re-represent the impressions received by all the lower centers and work them up into self-conscious mind. That is to say, there is a kind of psychical hierarchy, the lowest centers controlling the vegetative life; the middle centers controlling the motor life, while at the same time being inter-related with the vegetative life; and the highest centers mediating the intellectual and moral life proper, while at the same time being inter-related with all that is below them.

The importance of this view of psychical phenomena lies in the fact that it recognizes substantially the laws that we have just been discussing as operative also on the mental side. That is to say, in mental diseases the higher the level affected, the more diffuse and radical will be the psychical disequilibration produced. In general, this is confirmed in the well known distinctions between the peripheral and central lesions in brain disease. For example, locomotor ataxy produced by syphilitic infection may at first be due to the degeneration of a special region of the spinal cord. At this stage, there is a simple inability to co-ordinate the movements of the lower limbs, and the mind proper is not impaired. But as the degeneration advances upward to the higher levels the symptoms become more and more grave, until at last, when the centers that mediate the larger apperception groups become affected, profound mental and moral disturbances occur. Another important implication in Hughlings-Jackson's view is that of the greater instability of brain centers, and the concomitant psychical phenomena of the highest and most recently organized levels. According to this view, those centers which have been the last to develop and which are therefore the highest will be the first to yield to degenerative influences, since they are the most unstable.

Now, the moral sense, as we find it in civilized man, marks the culmination of the evolutionary process. Morality, in the race as in the individual, implies a high degree of complexity in the psychical organization. To be absolutely moral would necessitate apperceptions of the infinite; to be relatively so necessitates the apperception of very intricate personal and social relations. Representing the highest level of psychical organization, the moral sense is immanent throughout the entire complex of ideas and emotions. Just as the highest centers of the brain discharge their energy along every nerve-fibre and into every cell, so do the centers of moral consciousness discharge their energy along every channel of feeling. And just as the degeneration of the highest brain-centers throws out of equilibrium the entire psychical mechanism, so does the degeneration of the

moral consciousness destroy the soul. This is not a mere speculation. To say nothing of the testimony of religious teaching everywhere, or of that supplied in the history of decadent civilizations, there are all about us examples of moral degeneration which are accompanied by mental and physical degeneration. The immorality of the drunkard destroys his mind and his body by inducing morbid processes in the nervous and other tissues, by causing defective inhibition of other appetites, and by destroying gradually all that power of harmonious adjustment to environment which the race has built up. The drunkard is usually licentious and gluttonous, he is improvident, and he is generally deficient in his moral and intellectual perceptions. The same is true of opium eaters and all other victims of stimulants and narcotics. The immorality of the thief or of the dishonest business man affects the entire character. The sense of personal honor is one of the highest attainments in evolution. Destroy this sense, and almost everything else comes easy. Theft or dishonesty of any kind is always attended with falsehood and deception, and is often attended with such a loss of self-respect that vice of every description is recklessly indulged in. The immorality of unchaste men and women also affects the entire character. Sexual offenders of both sexes are notoriously untruthful, often dishonest, and sometimes cruel and depraved in every way. It is not entirely due to social ostracism that a woman who loses her virtue usually goes rapidly to the extremes of degradation, or that a business man who loses his sense of honor often takes to gambling, drinking, etc. In all such cases, the very highest apperceptions of consciousness are disturbed, and it is no wonder that a general moral obliquity results.

Again, and finally, just as the highest brain centers are the most unstable and the first to feel the effects of degenerative influences, so is the moral consciousness the most unstable and the most sensitive to stimuli of a harmful character. Illustrations of this principle are numerous. The moral natures of men everywhere show the effects of such an instability. The sudden break-downs of character frequently astonish and dismay society. A man fifty years old, who has been a good husband and father and an upright business man, decamps to some foreign country, and his relatives and friends are compelled to face the fact that he has defaulted for $250,000. A little later, and humiliation is increased a thousand-fold by the discovery that he has spent a large part of the money upon an adulteress and that he has now left home and family in the company of this woman. A young man who has been the trusted messenger of a metropolitan bank, and who has enjoyed the confidence and even the personal affection of his employ-

ers and associates, suddenly disappears with $30,000 of the bank's money. A minister who has an extensive reputation as a scholar, college president, and active citizen, and who is the husband and father in a cultivated household, puts all these things out of his life forever by eloping with a young woman who has been employed in his office. Such cases might be indefinitely multiplied. Now there is a disposition among some criminologists to explain these sudden lapses in moral conduct as symptoms of mental disease; and there is doubtless considerable truth in such an explanation in certain cases. But from the standpoint of moral evolution, which regards the sense of property, conjugal fidelity, and other elements of character peculiar to civilized communities as recent and unstable acquisitions, a different explanation is possible. From such a standpoint, it is reasonable to suppose that the susceptibility to temptations among men and women is a symptom not of mental disease but of a moral diathesis not yet fully established, and therefore unstable.

§ 7. Conclusions.

The proximate causes of that wide class of retrogressive phenomena variously classified as immorality, vice, crime and sin, may be summarized as follows:

1. *The temporarily incomplete elimination of qualities belonging to lower stages of development.* This type of immorality is illustrated in children whose moral nature has not yet adjusted itself to the standards of adult life; and in those adults whose development has been delayed, though not stopped, by unfavorable surroundings. Such immorality is transitional and temporary. It is analogous to the keel-shaped thorax and triradiate pelvis of childhood, and, like the latter, will be transformed at the proper time if the surrounding conditions be healthful.

2. *The total arrest of the eliminative process, leading to the persistence of qualities that should normally disappear.* This type of immorality is due to the fact that development has been arrested at some point in embryonic or post-natal life, thus perpetuating the psychical disposition of a normally transitional period. This marks the first stage of moral retrogression, and is illustrated in the delinquent classes generally, such as vagrants, thieves, sexual offenders, assaulters, etc. It is analogous to the numerous types of organic arrest. Thus the keel-shaped thorax referred to above may persist in what is called the pigeon-breast; the triradiate pelvis may persist in the rickety pelvis that, in woman, unfits for the reproduction functions; the fœtal lanugo may persist in the hairy covering that occasionally appears in men and women, etc.

3. *The hypertrophy or disease of abnormally persistent quali-*

ties, leading to a pathological condition of the moral nature. This type of immorality is due to very complex and obscure causes, but undoubtedly the simple persistence of animal and sub-human traits amidst an environment to which they are altogether alien is a prominent one. Just as the physical organism is apt to become diseased in surroundings to which it cannot adapt itself, so is the moral nature apt to become diseased in environments to which it cannot adapt itself. It is for this reason that an immoral character becomes self-destructive. Its existence depends upon harmonious adaptation to surroundings, which, in civilized communities, are essentially moral; and when this adaptation is impossible disease and death inevitably result. Moreover, it is undoubtedly true, as many authorities have asserted, from Morel down, that immorality accumulates through heredity. Families and communities degenerate from such vices as drunkenness, licentiousness, and the use of narcotics. It is not surprising, therefore, that the children of such families and communities should sometimes become morally insane. The higher and more unstable elements of the psyche are destroyed, the process of psychical elimination is stopped, and all the animal and savage traits of character assert themselves and dominate the individual. Here retrogression is far advanced, as is illustrated in such monstrosities of character as dipsomania, kleptomania, sexual perversion, and all those neurotic and unstable types of mind that constitute the decadent elements of society. This type of immorality has its analogues in the physical monstrosities that either make life abortive, or disfigure it with such blemishes as webbed hands and feet, cervical and facial fissures, hermaphroditism, etc.

No claim is here made to an original view of the nature of immorality. The idea that men's nature bears the traces of ancestral conduct that must somehow be eliminated is as old as the doctrine of "original sin." While the idea that immorality tends to become persistent and, finally, self-annihilating, is but a re-reading of the sentence "The wages of sin is death." Nor is it claimed that such a view explains the ultimate causes of immorality. What is back of all these phenomena of progress and retrogression is a matter of faith and not of knowledge. As in any other question to which the theory of evolution may be applied, it is the interpretation of facts that is changed, and not the facts themselves. The eternal truth that there is something in the universe that makes for righteousness, and something in the universe that makes for sin, will remain after science has said its last words. The most obvious implication of such a view of immorality is the unity and immutability of law. To say that the vices and crimes of men may be explained by nat-

ural methods is not to ignore supernatural methods. It is merely to assert the truth, which men have been too slow to learn, that *natural* laws are also *supernatural* laws. Both materialistic science and dogmatic religion are atheistic when it comes to an interpretation of nature, for neither believes that God has anything to do with it. How else could such antinomies as "natural law" and "spiritual law," "natural man" and "spiritual man" have been invented? To place the subject of immorality upon a basis at once natural and supernatural is the first desideratum in moral culture. When this has been accomplished men will be willing to learn Nature's methods of dealing with their vices and crimes, and they will at the same time perceive that these methods are too intelligent and beneficent to be explained on mechanical or chemical principles.

Considering the subject of immorality from such a point of view, what would moral pedagogy adopt as its guiding principles?

1. It would recognize that a large proportion of immoral tendencies are due to the incomplete elimination of animal and sub-human traits. These, however, are in process of elimination, and, under normal conditions, may be expected to recapitulate the phylogenetic process until the individual realizes the type of his race and civilization. That is to say, the process will be analogous to what takes place in the organism where such vestiges of an animal ancestry as the sublingua, palatal ridges, thyroid gland, etc., become more and more reduced as the child grows into the physical type of his race. Such a recognition would make moral education at once rational and optimistic. The task would be a hopeful one, because Nature would be on the side of the parent or educator; and it would also be a definite one, because both the conditions to be met and the means of meeting them would be better understood.

2. It would recognize that education as a moral agency must be chiefly serviceable during the periods of life that recapitulate the great groups of genetic instincts and habits. For it is then that the transforming influences of civilization must especially cope with hereditary tendencies, and it is then that the latter will be eliminated, if at all. Such are the periods of childhood and adolescence. The first of these is rife with food appetites, explosive emotions, and excessive egoism generally. It is here that gluttony, theft, deception, anger, stubbornness, destructiveness, filthiness, cruelty, and vagrancy are apt to reveal themselves. The dangers of the second period center in the awakening sex-consciousness. Here appear tendencies to sexual impurity, display and extravagance in dress, vanity, jealousy, and envy. The stress of moral education should therefore be placed upon these crises of development.

3. It would choose its methods of moral training in conformity with the suggestions of Nature, whose pedagogics are being reinterpreted by modern science, and especially by genetic psychology. It is believed that some of these methods have been emphasized in this study. First is that of conservatism. We have found that Nature works slowly and patiently. She has never extirpated a single organic structure or psychical quality outright, but has reduced them gradually. She has been satisfied to spend thousands of years in eliminating the animal and savage instincts of mankind, and even at this late day allows the children of civilization to pass through a savage or half-savage state, preliminary to the refinements of civilization. This means something to the parents and educators who will think about it. There is certainly prevalent a tendency to force moral and religious training upon children. The "thou shalt not" of moral discipline is too often concerned with the repression of healthy instincts. Children are forbidden to range the fields, climb trees, paddle in the water, and begrime themselves with dirt; they are cooped up in the prim little kindergartens, watched over by nurse girls, or led around in curls and smug costumes by dainty mothers. Truancy from school is made an offense punishable by confinement in truant schools; and boys whose instincts are often healthier than those of the officials who try to control them are made to believe that it is a crime to love the woods and watercourses better than the tedium of a school-room. It would be difficult to devise a surer way of emasculating childhood and of producing a precocious and morbid manhood and womanhood. Again, Nature eliminates by causing the organ to cease functioning and then allowing it to atrophy by withdrawing its nourishment. Here is suggested the rational process of moral training during the first period of development. It is not didactic moral or religious instruction that is needed in childhood so much as it is the prevention of injurious organs from functioning. This means that in the school and home the appetites and passions of children may best be reduced, not by laying down rules and preaching to children, but by removing the causes that excite their appetites and passions. If an organic structure begins to be reduced in size as soon as it ceases to function, may it not be that a disposition to lie or steal, or a tendency to outbreaks of temper, can be reduced in the same way? The exercise of continual caution in not tempting children to stubborness, destructiveness, theft, deceit, anger, envy, jealousy, etc., sums up the pedagogics not only of common sense, but also of evolutionary law. That is to say, the moral pedagogy of the first period of life is revealed in Nature's method of disuse and atrophy. *Where function of the immoral diathesis does not occur, reduction*

must inevitably follow. Finally, Nature's third method of elimination is that of the transformation of function. Here is suggested the rational process of moral training during the second period of development, namely, adolescence. This is the period when the whole egoistic nature normally undergoes transformation in the direction of altruism. All the feelings of conjugal, parental, and social affection that the race has built up through sex relationships and the love and care of offspring begin to awaken. The immoral tendencies incidental to such an awakening are peculiarly susceptible to the transforming process, for the very reason that so many healthy and useful directions may be given to the instincts that excite them. This is the period, therefore, for definite moral and religious instruction. Appeals may be made both to the emotions and the reason that would be utterly ineffectual in childhood. Religious teachers have everywhere recognized this fact, and have made the beginning of adolescence the initiatory stage to a religious life. Studies by Drs. Hall, Starbuck, Lancaster, and others, have discovered the psychological rationale of such a method, in the fact that adolescents are normally subject to marked religious experiences. We have here suggested, therefore, the method and the culture-material for adolescent education along moral lines The former is the transformation of the sex-diathesis in the direction of more advantageous functions; and the latter is moral precept and exhortation, and especially religious culture.

But, as we have seen, the elimination of the immoral diathesis is not the entire problem. When immorality becomes persistent and exaggerated into disease, Nature shifts the process of elimination from organs to individuals. Immorality, instead of being a phenomenon of incompleted development, becomes a phenomenon of arrested development and retrogression. It is of course impossible to separate the types of immorality. They blend into one another insensibly. It is therefore also impossible to say when moral education ceases to be effective. Certainly, human effort in this direction should never cease, for here as elsewhere faith should be larger than knowledge. Nevertheless, the cause of moral progress will be furthered by a recognition of the stern truth that moral retrogression, like physical retrogression, may advance so far that the extinction of the individual, community, or race, becomes certain. We know that physical degeneration reaches a point where the individual must perish as such, and where the propagation of offspring is stopped because Nature has rendered him sterile. Every type of monstrosity illustrates this, from hermaphroditism to the forms that are so misshapen that they cannot survive birth. On the psychical side, idiocy and insanity are illustrative; as

are also the graver moral delinquencies, such as drunkenness and licentiousness. Paul declared: "Neither fornicators . . . nor adulterers . . . nor abusers of themselves with mankind . . . nor thieves . . . nor drunkards, shall inherit the kingdom of God." The testimony of the scientist who has investigated the laws of organic and psychical development is not less emphatic.

Without, therefore, discarding indiscriminately the moral agencies that are at present employed in dealing with the worst types of immorality, is it not time that civilized society should lay the stress of its work upon the larger aspects of social regeneration, rather than upon the minutiæ of individual regeneration? Is it not time that Nature's methods of eliminating individuals as well as organs should be recognized and adopted? If it is the part of parents and educators to assist Nature in eliminating the forms of immorality that are due to incompleted development, why should it not be the part of society to assist in eliminating individuals and stocks in which immorality has become persistent and diseased? This, to be sure, is an enormously complex and difficult problem; but it is one that will sometime have to be met. Its solution must be found along two lines: (1) The removal of vicious and criminal persons from society, and (2) the prevention of propagation of their stock. Both of these methods are recognized at present in the imprisonment and execution of offenders, and in the prevention of idiots, etc., from marrying. But the methods must have a vastly wider application. The vicious and criminal must be weeded out and segregated permanently, and not, as now, for a term of a few years. There is certainly no greater legal travesty than that illustrated by the presence in such countries as England and the United States of thousands of criminals mingling with society, known to the police as "habitual offenders," but unmolested because they have served their "time" and have succeeded in covering up their tracks. Recently, a noted pickpocket known to the police circles of all the larger cities of the United States was seen in a certain city and arrested on suspicion. Nothing could be proved against him, however, and he was dismissed on condition that he leave the town; this, too, in the face of the fact that his picture has been in the rogue's gallery for many years, and that his career since boyhood has been divided between imprisonment and lawlessness.

Again, the vicious and criminal must be prevented from propagating their kind. If nature is busily at work rendering sterile such classes as the drunkards, roués and prostitutes, why should not society supplement the efforts of Nature and complete the process? Here, again, society enacts thousands of judicial travesties yearly in fining such habitual delinquents and then turn-

ing them loose to continue their gratifications of appetite and lust, meanwhile begetting offspring that shall spread the curse of evil into other generations. The segregation of persistent and diseased immorality, therefore; the prevention of marriage among delinquent classes; and, in extreme cases, perhaps, stirpiculture, are the methods that Nature suggests to society in any rational attempt to effect its own regeneration. However stern such methods may seem, and however difficult of application, they are not more stern or difficult than the forces that are everywhere in nature making for progress and against retrogression. Here, as elsewhere, that individual and that society which interprets the laws of Nature and applies them, is not only wise, but is also a benefactor to the present and future generations.

MINOR STUDIES FROM THE PSYCHOLOGICAL LABORATORY OF CORNELL UNIVERSITY.

Communicated by E. B. Titchener.

XIX. Visual Reading: A Study in Mental Imagery.

By W. B. Secor, B. S.

INTRODUCTION.

The question before us in the present Study is: Is it possible to read without mentally hearing the words, and without feeling them in the throat, the mouth, or on the lips? Can one grasp the meaning of printed or written matter through the eye alone, without the aid of articulatory or auditory images? In other words: is it possible to pass from the visual word directly to the sense, without the mediation of articulation or audition?

The word as sign of an idea may exist in the mind in four ways: as auditory image, as visual image, and as motor image either hand-motor or articulatory. The four centers in the brain corresponding to the four ways in which a word may exist as an idea-sign are pretty well localized. If we were to judge *a priori*, we should say that two of these centers, namely the auditory and articulatory, must be more firmly organized and better correlated than the other two, inasmuch as they have been in use ever since the race began to utilize vocal signs for communication; the word has been a sound or an articulatory movement for an incomparably longer time than it has been a visual or hand-motor image. What is true of the race is here also true of the individual; the child learns to speak and hear words as words some time before it learns to write or to recognize the visual word. Besides the advantages of priority of development in the race and in the individual, the auditory and articulatory centers have the further advantage of being much more constantly in use with the majority of people than the visual and hand-motor centers. For these reasons, then, one is led to conclude that the auditory and articulatory word must necessarily be a much more persistent and prominent factor in language than the visual or hand-motor word.

This *a priori* conclusion is borne out by the facts gleaned from experiment, and by everyday observation. Three out of four

of the subjects of this Study have both audition and articulation in ordinary reading; the fourth has only audition, but this is very persistent. All said that they usually thought in auditory terms, and some have the articulatory accompaniment as well. On the other hand, none of them see words (have the visual word) when thinking or when talking.

It is a significant fact that the subject who seems to be most predominantly visual has had the greatest difficulty in deciding whether she does or does not see the word while talking. When conscious of being under experimentation, she always sees the words as they are spoken. The method employed here was to induce the subject to talk, while unconscious of the experiment, and then ask her to introspect as to whether she saw the words as spoken. Invariably, when she was thus asked, the words last articulated would flash before her mind in visual terms. For some time it was hard to discriminate between visualization thus occasioned by the question, and the real composition of the mind during speech. After some practice, however, introspection gave a definite verdict that there was no visual imagery of spoken words. The other subjects, who were not so decidedly visual, said that they never or scarcely ever saw words as they thought or talked; some even found that an effort was required to see the words spoken by themselves, even when they wished to do so. The fact that the subject who was most decidedly visual in type found it difficult to determine whether visual images of words were present during speech, while others of a less decided visual type found little or no difficulty in determining that they were absent, is a useful confirmation of our *a priori* theory. It further shows that the prominence of the visual, auditory or articulatory word depends somewhat upon the type of the individual.

Another element of scarcely less importance than the preceding would seem to enter here. Since, as we have seen, the peculiar prominence and persistence of auditory and articulatory imagery are due to its greater use by the race and the individual, we should naturally suppose that practice or continued use would have the same effect in bringing visual imagery into prominence. This seems to be a correct conclusion: for the degree to which audition and articulation are banished from reading, and the extent to which visual words occur in ordinary talking, appear to depend upon the amount and kind of reading done by the subject. If he has intellectual tastes, and has been accustomed to studious habits and consequently to much reading from youth up, other things being equal, audition and articulation will tend to become less and less distinct and finally perhaps fade out entirely, while the visual word will become more and more prominent. This conclusion is borne out by our ex-

periments, so far as they go, although four subjects could furnish only very meager data for so general an inference. The subject with whom the auditory and articulatory elements were of little importance, and the visual of somewhat more than ordinary importance, was D., a Graduate Student about to take the examinations for the doctorate in philosophy. She must necessarily have done much reading. A second subject, Wh., was a second year candidate for the philosophical doctorate, and had probably read less that D., but much more than the average college student. With Wh. the articulatory element was almost entirely lacking. The visual word was not developed to any great extent; yet he could see the words spoken by himself, with a little effort. The other two subjects, Wi. and O., a Senior and a Junior respectively, differed but little in the prominence of the auditory and articulatory factors, the articulatory being a little more prominent in the former than in the latter. Neither saw the words that he used, without a considerable effort.

I. Memory Types.

As already indicated, the mental constitution or type of the individual has much to do in deciding the place that each sense shall have as a factor in reading. It is quite important, then, in experiments of this kind, that the type shall be known. The first method employed to ascertain this fact was as follows. (*a*) A word is written on the blackboard by the experimenter, the subject having his eyes closed. At the signal "Now," the subject opens his eyes and looks at the word. The word is then immediately erased and the subject asked to say whether he had auditory and articulatory images of the word, and what further imagery was suggested by the word as a word. We give here replies, one from each of the four subjects, each being as far as possible characteristic. Following this is a tabular form, showing the results as to kind of imagery suggested by the word in each case.

(1) The word "Slate-roof" was placed before Wi. Introspection was as follows. "I heard the word very low, as if spoken by myself. There was a little movement of, or effort to move, the tongue. I saw the top of the Armory with a slate-roof on it, a good distance off. The slate was grey." (2) The word "organ" was presented to Wh. Introspection was as follows. "I heard the word but had no articulatory feeling. I started indistinctly to visualize a general organ in front of me, then I had the sensation of turning towards the Chapel, and visualized the organ there. I heard some notes in the sound of my own voice, like *too, too, too, too.*" (3) The word "steam-whistle" was presented to D. Introspection was as follows.

"I had no articulatory or auditory images of the words: the meaning just came from seeing the word. First I heard the high, shrill whistle of a locomotive, then I had a visual image of the whistle with the steam all around it, as it is sometimes seen. In the background was a locomotive, very ill defined." (4) The word "Ink-stand" was presented to O. He introspected as follows. "I heard the word, and there was a slight articulatory feel on the end of the tongue. A glass ink-stand flashed before me, about arm's length away."

The imagery of the different subjects was studied by another method also. (*b*) Each was asked to reproduce the matter read in the experiments presently to be described, and then to tell just how he reproduced, *i. e.*, whether in auditory terms, visual terms, etc. This experiment, as well as throwing light upon the type of the subject, was a means of assuring the experimenter that the subject had actually read the paragraph assigned rather than merely glanced it over.

The first experiment, in which the words were presented, showed all four subjects to be of a decided visual type. Both the methods showed D. to be distinctly visual in type. The visual images were not especially clear-cut, but they were profuse and detailed, *i. e.*, all parts of an object or scene had their counterparts in the visual image. The image could be recalled and examined at will some time after it had vanished. The subject is able to read from a visualized page, not of course with the degree of surety that would accompany the reading of a real page, but still with tolerable accuracy. She sometimes reproduced short paragraphs in this way. The usual way of reproduction in such cases was, however, to reproduce from the visual pictures formed when reading the paragraph, with aid also from various visualized words. This subject, as we have said, was the most decidedly visual of the four.

The next in order was Wh. His visual imagery was as clear-cut, perhaps, as that of D., yet it lacked the detail and profusion. In his imagery in general he drew upon more senses than the others, *i. e.*, his type was more mixed.[1] Notwithstanding the fact that he was decidedly visual, he had a strong tendency to be ear-minded. He usually heard as well as saw that which was suggested by a word, the visualization invariably coming first, however. In reproducing the paragraph Wh. depends mainly on the visual picture, the visual word and the

[1] Wh. differs from D. in having more images as regards variety, but less profuse and detailed imagery as regards quality. It would be a very interesting study to determine whether there is any special relation of dependence between these two factors; to ascertain, *e. g.*, whether detail is inversely proportional to variety of imagery, as this instance seems possibly to indicate.

TABLE OF IMAGERY.[1]

WORDS SHOWN.	D.	WH.	W.	O.
Driftwood	V	V	V	
Waves	V	V	V	
Violet	V & M	V	V	
Book	V & P	V	—	
Salt	Gus & V	Gus. V. M.	V	
Quail	V & A	V	Gus. & V	V
Sea-shell	V	V & A-verb	V?	V
Waterfall	V	V & A	—	V
Rose	V	V & olf. ?	V	V
Wet sidewalk	V & M	V & org.	V & olf.	V
Railroad	V & A	V	V	—
Springtime	V	V	—	V
Infinity	—	—	A-verb	V
Fog	V	V & org.	V & A & A-verb	A & A-verb & V
Dog	V	V	V	V
Leaves	V	V & A & A-verb	V	V
Expanse	V	M & V	V	—
Bright day	V	—	V & A?	—
Brimstone	V		—	V
Forest	V	V	V	V
Whistle	V & A	A	V	A
Summer night	V & olf.	A & T	V & A & A-verb	V
Steam	V	V & A	V & A	V
Picnic		V	V	V
Fog-horn		V	—	V
Landscape		—	V	V
Fire		V & A	V & T	—
Blackbirds		V & A	V & A	V
The morning wind		A & V	V & A	A
Glowing horse shoe		V & A	V	V
Flute	A & V	V. M. A.	—	A & V
Ice-water	T & V	V. M. T.	V	V?
Brass-band	V	V & A	V & A	—
Horse	V	V & A	V	V
Bees	—	—	V & A & A-verb	—
Robin	V & A		V	V
Chimes	V & A		V & A & A-verb	V
Kerosene	V		V & org.	V
Grass	V		A & A-verb	V
Red-squirrel	V		V	V
Skaters	V		V	—
Lamp	V		V & olf.	V
Blue-book	V		V	V
Tobacco	Olf. & V		V & olf.	V
Steel	—		A & A-verb	V
Slate-roof	V	V & A	V	V
Partridge	V	V & A	V	V
Distant bell	V & A	V & A	V & A	—
Street car	V. A. P?	V	V	V
Camphor	Olf.	V. M. olf.	V	V
Knife	V	V. M. A.	V	V
Cigar	Olf. & V	V. P. gus.	V & gus.	V
Sandy bar	V	V. A. T.	V & A & A-verb	V
Deep-voiced ocean	A & V & A-verb	A & A-verb & V	V & A	V
Forest primeval	V	V & A & A-verb	A & A-verb	V
Piano	V	V & A	V	V
Steam	V. A.	V & A & P	V	V
Valley	V. A.	V	V	V
Envelope		V. A. M. gus.	V	V
Lavender		A & A-verb V	V	—

[1] In this Table, V = visual; A = auditory; M = muscular; T = temperature;

TABLE OF IMAGERY.—*Continued.*

WORD SHOWN.	D.	WH.	W.	O.
Rising tide		V & A	V	V
Watch	V & A	V & A	V	V
Sleigh-bells	V. A.	A & V	V	A
Key	V	V & M	V	V
Engine	V & A		A & V	V
Violin	V & A		V & A	V
Headache	S	V	—	—
Organ	V	V	V	V
Bicycle	V & M	V & M	V	V ?
Chickadee	V & A	V & A	V	—
Steam-whistle	A & V	V & A	V	—
Ink-stand	V & G	V	V	V
Light	V	—	V	—
Smoke	V		V	V
Soldiers	V		V	—
Darkness	V		—	—
Postage-stamp	V		V	V
Church-steeple	A & V		V	V
Umbrella	V		V	V
Box	V	—	V	—
Child	V	V & A	V ?	V
Empty barrel	V	V	V	V
Flies	V & A			
Foot-ball	V & A			
Clock	V			
Machine	V & A			
Eye	V			
Xylophone	V & A			
Trench	V			
Newspaper	A & V			
Sparrow	A & V			
Hen	V			
Tennis court	V & M			
Field of grain	V			

S = strain; olf. = olfactory; org. = organic; P = pressure; gus. = gustatory; A-verb = auditory-verbal. A blank space indicates that the word was not shown to the subject in question; a — that introspection revealed nothing but visual-verbal elements.

accompanying auditory word. Wh. is a musician, and sings as well as plays. He says that he invariably has a tune in his head when not engaged in serious study or thinking; he sometimes chews in time with a tune when eating.

Both methods show Wi. to be a visual, yet he depends on other senses to some extent. In reproduction the visual picture suggested by the sense is the main factor; he is, however, assisted by visual words. The words thus visualized are always heard as well as seen. His images are fairly clear and well defined. They are not especially detailed or profuse.

The experiment in which words are presented shows O. to be a visual, yet his visual images are indistinct and ill defined. He often visualizes pictures of objects rather than the objects themselves. In the reproduction of matter read, visual pictures do not play an important part; in fact they are almost entirely absent, and he says that he reproduces from the "sense." He seems inclined to identify 'sense' with audition, and to say that he reproduces in auditory terms. He always, however, gives back the paragraph in his own words rather than in the

words of the book: which suggests that auditory images are not really a prominent factor in his reproduction. It is quite probable that his mode of reproduction is very complex, being composed of elements from many of the senses. These elements by use have become so fused and knit together that the resulting complex seems like a unity, which does not resemble the imagery of any one sense, and can be given no better expression than by the phrase 'reproduction from the sense.'

II. Reading by Vision Alone.

In attacking the problem of the possibility of reading without articulation and audition, two general methods are available. One might try an indefinite number of people until one or more should be found who could read without the articulatory or auditory accompaniment; or one might select three or four subjects, and, placing them under conditions which would tend to decrease or fade out the auditory and articulatory elements, so train them that it should become possible for them to read by the aid of the eye alone. Either method, if pursued far enough, would furnish a solution of the problem. The former, however, hardly seems practicable. Too much time would be required to train each subject to introspect well enough for scientific purposes. And, even were this time at our command, it would be difficult to obtain the required number of subjects. Moreover, there is a bare chance that reading without audition and articulation is possible, and yet that no one under ordinary conditions would read in that way. The second method is, therefore, the one followed here.

The nature of the problem makes it difficult to use any but general checks upon the pure method of introspection. Hence, with one exception which will come out later, the results here recorded are the product of introspection under general control. The subject performed the experiment as directed by the experimenter, and then gave his introspection in answer to various questions, which were calculated to bring out the information required. Great care has been taken to avoid what sometimes occurs in the act of introspection, the reading into the introspection of that which occurs after the experiment is concluded, and at the time of introspecting, rather than the giving a true account of what happened when under the conditions of the experiment.

(*a*) The first specific method employed was as follows. The subject was given a book and asked to read a certain paragraph as rapidly as possible. This was with the expectation that the eye would outrun the ear, thus leaving it behind, and allowing the auditory element to drop out. The method was varied by asking the subject to read the first part of a paragraph at ordi-

nary speed and the latter part as rapidly as possible and *vice versa*, thus making possible a comparison between the imagery aroused when reading at the normal speed, and that aroused when reading at the maximal rate. The results obtained were fairly constant with three subjects, but varied with the fourth. With the three, the audition and articulation were less prominent than in ordinary reading. They were less prominent, because a less noticeable factor in consciousness. Two of these subjects (O. and Wh.) say that some small words are not heard at all, and that others are not heard distinctly. Besides this general tendency to fade the images seen in rapid reading, O. and Wh. find another difference. They hear the words in each case about as they would articulate them. When reading slowly there is plenty of time for full round articulation, but in rapid reading the words are heard as slurred and indistinctly pronounced, as when talking rapidly. With D. rapid reading fades both audition and articulation, the latter sometimes being absent altogether, while the former becomes a very indistinct factor. Wi. finds that, when he is trying to hurry the reading, the auditory element becomes more distinct and noticeable; the articulation, however, sometimes becomes less distinct. On the whole, then, the general tendency of the method seems to be to make the auditory and articulatory factors more indistinct. In no case has it succeeded in banishing the auditory element; but, on the other hand, Wi. O. and D. often say that they had no articulation.

(*b*) The second method employed was calculated to shut off, if possible, the articulatory element, while it also affected audition. The method was as follows. The subject was asked either to say the alphabet aloud or to whistle a tune while reading. The results of this method were somewhat startling. It completely removed all traces of articulatory movement, so far as the possibility of discovering this by introspection is concerned. All subjects throughout the year, with very few exceptions (D. thought a few times that there was a slight tendency to articulate, but by far the great majority of her judgments say that there is no articulation), found no articulation present under these conditions.

It was thought that there might be certain articulatory movements during the intervals in which the organs were not occupied in forming the letters or the tones, and that on account of the general articulatory movement, accompanying the saying of the alphabet or whistling, these interstitial movements would be overlooked by introspection. To guard against this, the method was varied by asking the subject to read while articulating a certain letter, prolonging the letter as much as possible. The results only verified those of the original method. Artic-

ulation was completely eradicated. The method was varied still farther. To ascertain whether conscious voluntary movement of any part of the body might not remove the tendency to articulate, in the same way as the above method,—or at least produce the same apparent result by distracting the attention, thus showing the first results to be a mere distraction of attention, rather than a removal of the tendency to articulate,—the subject was asked to clap the hands, swing the feet, trot the foot, etc., while reading. These movements did not seem to interfere in the least with the articulatory tendency. The result indicates that the results obtained from the two former methods were not merely apparent but real.

The Verdin laryngograph was now applied to the throat, as a check to the introspective method in its application to articulation. This instrument indicates movement of the larynx by tracing a curve on the kymograph cylinder. It can, of course, detect only actual movements of the larynx and movements of some magnitude; it cannot indicate subliminal movements, or the presence of a purely mental articulatory image. The laryngograph was supported from the chest, so that the breathing movements caused the pointer to trace a regular wave-like curve on the cylinder even when there was no movement of the vocal organs. The method first pursued was to obtain a breathing curve, and then lower the cylinder and trace another curve just above the breathing curve, the subject reading silently while this second curve was being traced. These two curves, one above the other, enabled the experimenter to compare the one with the other, and detect any irregularity indicating movements of the larynx. It was soon found that, although the instrument allowed itself to be adjusted so that very slight movements could be detected, it was very hard to determine just what irregularities of the curve were the result of articulatory movement proper, and just what were due to some accidental movement of the subject. A method which should allow for more precision and certainty was therefore necessary. The following method was then devised. After tracing the breathing curve, the cylinder was lowered, and a curve was traced just above it while the subject read aloud in time with a metronome, reading one word at each beat. The cylinder was then again lowered, and the subject read silently the same matter as before in time with the metronome,—thus tracing a third curve above the other two. The part of curve 2 which represented the articulatory movement for any word had its duplicate in the curve above, in case there was any articulatory movement when the subject read silently. This made the detection of any movement of the vocal organs a fairly simple matter; yet the

reading in time with the metronome favored articulation, rather than tended to check it.

The results of the laryngographic test correspond very well with the introspection of the subjects. With Wh. and D. the curves show no articulatory movement. Wh. never finds any articulatory tendency when he introspects, while D. never finds movement, but sometimes has the articulatory feel. The curve indicated movement in the case of Wi. and O. Wi. is a mouth reader, and almost always finds articulation present when he introspects; while O. finds articulation present to a greater or less extent.

The success in shutting off the articulatory element, by the occupation of the articulatory centers with other stimuli, suggested the idea that the auditory factor might be eliminated in a similar way. The method was this. (*c*) The subject read a paragraph while whistling or saying the alphabet, and the experimenter played on a xylophone at the same time. The experiment was intended to shut off both articulation and audition. The results, though not so startling as those of the former method, are nevertheless quite decided. D. found that both articulation and audition were usually absent when she read under these conditions; that the meaning came as a direct result of the visualization without the mediation of auditory or articulatory elements. Wh., in whom articulation is invariably absent, and audition invariably present, finds that his auditory images are a much less distinct and noticeable element, when reading under these conditions. They do not seem as loud and do not occupy as prominent a place in consciousness as ordinarily. The results obtained from O. are very similar to those from Wh., except that, while ordinarily having articulation, he now finds it absent. Wi. finds the articulatory element eliminated, but the auditory still persists with as much vigor and force as ever.

The methods thus far described are those which were the most fruitful. Another, employed as a possible check upon the foregoing, was suggested by Dr. T. L. Smith, who was experimenting at the time upon a cognate problem. It takes advantage of the fact that there are certain classes of consonants whose formation requires distinctly different positions of the vocal organs (dentals, labials, gutturals). The subject was seated before an exposure-screen, with eyes closed. At a signal the eyes were opened to see a letter exposed on the screen. Shortly (1-1.5 sec.) after the signal for opening the eyes was given, and at a moment when the subject would have had about time to apperceive the letter, the experimenter pronounced a word containing an initial or final consonant taken from the same group as the letter exposed (*e. g.*, expose *t* and say *dot;* expose *b* and say *pelt*). This procedure was varied by ex-

posing, for example, a dental, and pronouncing a word beginning or ending with a labial or guttural. The value of the experiment in the present case would lie in a comparison of the introspections under the two different conditions. For Miss Smith had found that when the exposed letter was followed by a word beginning or ending with a similar letter, the subject invariably saw the word pronounced, but with the letter exposed in the place of the true initial or final letter. When, *e. g.*, *t* was exposed, and *dot* pronounced, the subject saw *tot*. On the other hand, when the letter was followed by a word whose initial or final letter belonged to a different class, the subject saw the word pronounced with the exposed letter hovering about in space near the incongruous initial or final. When, *e. g.*, *d* was exposed and *pelt* pronounced, the subject saw *pelt*, but somewhere near the *p* he also saw the *d*. The *d* "seemed to be trying to get into the word." The above are results obtained by Miss Smith from a subject whom we had supposed to be of a practically exclusively visual type. They showed that there was an incipient tendency in this subject to articulate, or at least that there was something besides the visual element as a factor in reading. This element, which had escaped introspection, was discovered by this method. It therefore seemed worth while to employ the same procedure with D., with a view to discovering whether there was with her, too, this other and elusive element in reading. The following are a few of the most characteristic results.

(1) Exposed *d* and said *then*.

"The auditory sensation of the word, and the visual sensation of the letter both came at the same time; then the visual image of the word behind and to the left of the letter, and having no connection with the letter whatever."

(2) Exposed *t* and said *throat*.

"The two sensations (aud. and vis.) came together; then came the visual image of the word, and a visual picture of the inside of the throat. There was no connection between the visual image of the word, and the visual sensation of the letter."

(3) Exposed *b* and said *top*.

"The two sensations came simultaneously; then a visual image of the word and of a top; also the actual image of the feel of a top between the fingers."

These and many similar results show clearly that with D. there was *no* incipient tendency to articulate. In general the letter exposed and the word articulated by the experimenter were separately and distinctly perceived, no relation existing between the two. D.'s introspection, then, is verified by this check.

(*d*) Other methods were used without any decided results that would help in solving the problem before us; *e. g.*, a word was selected from a paragraph and placed on the blackboard.

The subject was asked to look at the word, and then glance rapidly down the page until he found it, getting the sense of the page as far as possible. He then gave his introspection and stated whether he had any auditory or articulatory images of the words glanced over. Little resulted from this method, except that the word was usually found before the subject had reached it in reading. This shows that the eye is appreciably ahead of the sense in reading, a fact which has been pointed out by others.

To see what effect a strange or new element in the kind of letters used would produce, the subject was asked to read matter in which the long S was used. Three of the subjects had distinct auditory images of a sound which is a cross between an S and F, a sound like the lisped F. The fourth subject did not have this experience, but sometimes read the S as an F, and had to reread to correct the error.

There are certain conditions under which the articulatory, auditory, and visual imagery are much more distinct than usual. When the subject for any reason stumbles on a word, and has difficulty to grasp it at first, or tries to read a foreign word, the articulatory and the auditory imagery are much more marked; they seem to serve as aids to overcome difficulties in obtaining the sense. In reading dialogue the auditory element is more distinct than usual, with some subjects. The visual imagery of italicized or capitalized words is more persistent than it is for words not thus made conspicuous.

Summary.

The results of these experiments as a whole are as follows:

(1) The auditory element is a much more persistent factor in reading than articulation.

(2) Both articulation and audition are to be regarded as aids in reading, rather than absolutely necessary elements.

(3) The prominence of the auditory and articulatory elements in reading depends upon the type of the individual, and upon the amount and kind of reading done by him.

(4) It is possible to read without articulation and audition.

MINOR STUDIES FROM THE PSYCHOLOGICAL LABORATORY OF CLARK UNIVERSITY.

COMMUNICATED BY EDMUND C. SANFORD.

XV. AUTOMATIC MOVEMENTS OF THE LARYNX.[1]

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Automatic movements of the hand are demonstrable in many normal subjects, and with a little cultivation can be brought nearly or quite to the verge of automatic writing.[2] What is true of the hand is of course measurably true of other members, the chief requisites being, apparently, a high degree of mobility in the member and a temporary abstraction, or at least inattention to it, on the part of the subject. These requirements are very well fulfilled by the vocal mechanisms, which are, perhaps, the most mobile in the body, and at the same time are out of the visual field, and function with a minimum of direct attention. A further interest attaches to their activities on account of the large part which language plays in the ordinary course of thought. The experiments of Hansen and Lehmann[3] show clearly the tendency of these organs to automatic activity, and the experiments about to be described add confirmation. The chief interest of the latter, indeed, lies in showing that such movements are very common with normal people, and are comparatively easy of demonstration.

The essential part of the apparatus used was nothing more than two tambours: a receiving tambour applied to the larynx, and an inscribing tambour writing upon the smoked surface of

[1] The experiments recorded in this paper were made in the spring of 1897.

[2] Binet: Double Consciousness in Health, *Mind*, XV, 1890, 46–57. Jastrow: A Study of Involuntary Movements, *Amer. Jour. Psy.*, IV, 1892, 398–407; V, 1892, 223-231. Tucker: Comparative Observations on the Involuntary Movements of Adults and Children, *Ibid.*, VIII, 1897, 394-404. Solomons and Stein: Normal Motor Automatism. *Psy. Rev.*, III, 1896, 492-512. Stein: Cultivated Motor Automatism, *Ibid.*, V, 1898, 295-306.

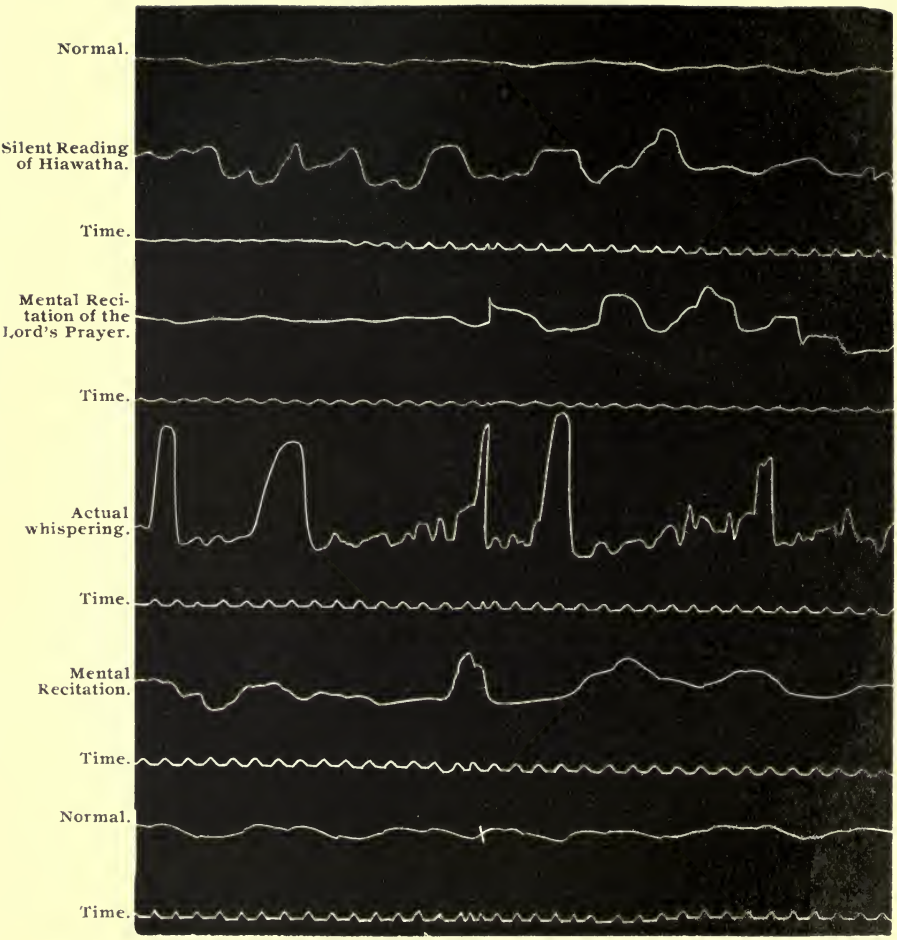
[3] Hansen and Lehmann: Ueber unwillkürliches Flüstern, *Wundt's Philos. Studien*, XI, 1895, 471-530.

a kymograph drum. The inscribing tambour was of the ordinary Marey pattern; the receiving tambour was a home-made one of about the same size, on the rubber face of which a cork —trimmed to receive the tip of the larynx—had been fastened with rubber cement. The rubber face of this tambour had been further stiffened (as in other of the Marey instruments) by a weak spiral spring within. In order to hold this tambour in place against the larynx it was necessary to provide a special means of support. This was secured as follows: Two brass rods were fastened on the sides of an old stiff hat in such a way that they came down beside the cheeks of the subject when the hat was on his head, and extended below the level of his larynx. These were connected near their lower ends by a cross rod securely clamped to both. To this cross rod was clamped in turn a thin lead rod, near the end of which the receiving tambour was fastened, the lead rod, by its partial flexibility, making the regulation of the pressure of the tambour on the larynx fairly easy.[1] During the experiment the subject was comfortably seated in a reclining-chair with his head supported. On the drum a time curve in half seconds was traced by a third and independent tambour.

The usual course of experimentation was as follows: The subject having taken his place in the chair and the apparatus being adjusted, he was told to remain passive and avoid mental effort (or sometimes to keep his thought as much as possible in visual images) while a "normal" tracing should be taken. He was next asked to recite some familiar poem mentally, (or the Lord's prayer, if no poem was in mind,) while a similar tracing was taken for comparison. He was then asked to whisper the same selection, and tracings of this and of other variations of the task were taken till the drum was full. In some cases tracings were also taken when the subject read to himself from a book mechanically supported at the proper distance from his eyes.

In the accompanying plate is reproduced a portion cut from a sheet of such tracings. The curves read from left to right and were taken in pairs (time curve and larynx curve) successively from the bottom upward. Beginning at the bottom the first pair shows a "normal" curve in which the irregularities are due chiefly to pulse and respiration. The crowding of the points in the time curve about midway of the portion shown betrays a tendency of the drum to stick at that point—a matter

[1] The apparatus was evidently rough, but, as it was thus calculated rather to fail in recording the finer laryngeal movements than to exaggerate them, such records of movements as were obtained are not invalidated by it.


Normal.
Silent Reading of Hiawatha.
Time.
Mental Recitation of the Lord's Prayer.
Time.
Actual whispering.
Time.
Mental Recitation.
Time.
Normal.
Time.

of no special importance here, but one that would have to be taken into account in any minute study of the curves. The second pair shows the greatly increased laryngeal movements accompanying mental recitation of a portion of a poem. The third shows the still greater disturbances accompanying whispering. The fourth pair is interesting as showing how the laryngeal movements vary with the energy of the inner speech. Up to about the middle of the portion shown the curve is indistinguishable from a "normal," beyond this point the effects of the laryngeal movement are very marked. During the first part the subject was repeating the Lord's prayer to himself in a perfunctory way without thinking what he was doing. It then occurred to him that, perhaps, this was not what the experimenter wanted and he thought of himself as repeating it before an audience at church; with what result is evident. The fifth pair shows the curve obtained from silent reading in "Hiawatha," and the last (single) curve is a final "normal." The subject was for the most part unaware of the movements of his larynx during the taking of the tracings of inner speech, noticing them but "once or twice."

It is only fair to say that the tracings shown in this plate are not average tracings, but are selected as showing the differences in question in a decided manner; they are not to be regarded as unique however. Forty sittings were taken in all, with twenty different subjects. Of these, sixteen were university students, three were boys between fifteen and nineteen years of age, and one was the university mechanic. Of the forty sittings, eighteen show clearly marked automatic movements of the larynx in some or all of the tracings; eleven show smaller but still distinguishable variations; while the remaining eleven show hardly any difference between the "normals" and the other curves. Of the twenty subjects, fifteen show automatic movements. Four of the remaining five do not show movements even in whispering, and so could hardly be expected to show them with wholly silent speech. The remaining subject served but a single time and tried successfully to suppress all movements. The extent of the movements differed considerably, not only from subject to subject, but with the same subject at different times, being hardly distinguishable at one time and fairly marked at another—a result attributable in part to the difficulty of getting the receiving tambour properly adjusted and partly to different conditions in the subject himself, especially to the energy of his mental speech.

Taken together with the experiments of Hansen and Lehmann these experiments seem to put it beyond question that automatic movements of the speech organs do take place and are far from uncommon.

XVI. Zöllner's Anorthoscopic Illusion.[1]

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In 1862 Zöllner described a modification of the anorthoscope consisting merely of a sheet of stiff black paper in which had been cut a slit of about two by forty millimetres, and a strip of white cardboard upon which any simple geometrical figure had been drawn.[2] By passing the white strip rapidly to and fro behind the slit the figure (a circle for example) is compressed laterally. Very slow rates give a corresponding lengthening of the figure. This illusion he distinguishes from those of the anorthoscope proper—where the distorted figure is merely a summation of a series of partial views of the true figure.

Helmholtz, in correspondence with Zöllner, and later in his Physiological Optics,[3] suggested a physiological explanation for the lateral compression with fast rates, and a psychological one for the extension with slow rates. In his opinion the first is due to a movement of the eyes in the same direction as the figure, which would bring the experiment under practically the same principle as the ordinary anorthoscopic illusion, and the second depends upon the well known principle of the overestimation of small angles. Zöllner prefers a different psychological explanation in the second case, and points out that a psychological explanation is also probable for the illusion in the first case if it can be established that eye-movements are not concerned. To demonstrate this he placed a small mark half way up the slit, and made the experiment while the eyes were held steadily on this point. The result was the same as with free eyes. The illusion in the first form is obtained also, he says, with rates so slow that the question of after-images cannot be involved. He is, therefore, inclined to believe that the double illusion is due to an underestimation of fast rates, and a corresponding overestimation of those that are slow.

The illusion and the rival methods of explanation are interesting enough to invite a reinvestigation. A first step is, of course, to simplify the conditions and, in particular, to substitute a uniform movement in one direction for the variable to and fro movement of the hand apparatus. This was accomplished by drawing the figures upon a continuous band of paper

[1] The experiments here described were made in the fall of 1896 and spring of 1897.

[2] Zöllner: Ueber eine neue Art anorthoskopischer Zerrbilder, *Poggendorff's Annalen*, CXVII, 1862, pp. 477-484.

[3] Helmholtz: Physiologische Optik, 2 te Aufl., p. 749.

carried on cylinders driven at a fairly constant rate.[1] The illusion was found to persist in unmistakable force and with fixed as well as free eyes. Indeed, the usual posture of observation taken by the subjects of their own accord consisted in fixation of the edge of the slit where the figure disappeared. Zöllner's explanation seems quite safe from attack on this ground.

A natural second step, and one suggested by Zöllner himself, is a quantitative study of the illusion. This is particularly interesting here, because the reversal of the illusion with the change from fast to slow rates promises an intermediate rate at which there should be no illusion—a rate, if Zöllner's explanation of the illusion is correct, which would be estimated without error. In order to avoid certain special factors of illusion which attend the use of a circular figure, a solid black square, 47 mm. on a side, and moving in the direction of one of its sides, was employed. Determinations were made for three widths of slit, 5 mm., 20 mm. and 47 mm. and for three rates of motion, 2.2, 4.9 and 25 cm. per sec. Thirteen subjects gave estimates of these nine cases, estimating each a single time, and nine of the subjects repeated the estimate a second time. The estimates were indicated by the subject on a suitably shaped strip of cardboard—not given in figures.[2] The first half of the following table gives the averages of the first estimates of the thirteen subjects; the second half the average of the second estimates of the nine subjects that made them.

	Rate.	25 cm.	M. V.	4.9 cm.	M. V.	2.2 cm.	M. V.
Aperture.	5 mm.	20.7	8.0	59.3	12.2	70.9	13.3
	20 mm.	29.5	4.4	54	6.3	60.5	8.5
	47 mm.	42.4	2.8	47	1.5	47.6	1.4
Aperture.	5 mm.	24.7	7.2	58.5	11.9	68.6	13.2
	20 mm.	34.0	3.8	55.4	4.8	65.3	9.9
	47 mm.[1]	44.1	1.6	51.0	4.3	50.0	4.0

[1] Estimates of 8 subjects.

Though the figures are rough as might be expected from the

[1] The driving power used consisted of the clock-work and weights of the large Krille Chronograph (pictured and described in Wundt's *Physiologische Psychologie*, 4 te Aufl., II, 338 ff). This, unfortunately, does not, at least in the example in the Clark laboratory, give a wholly uniform rate of movement. The variation was not sufficient, however, to affect the general results of the experiment.

[2] [A possible exception to this is when the subject reported the figure as "square" without using the card. E. C. S.]

combination of the estimates of different observers, the general results are perfectly clear. The extent of the illusion diminishes as the width of the slit increases, and is almost wanting for a width of slit equal to that of the square (47 mm.). It is also probable, though it would need a more varied series of rates to prove it absolutely, that the illusory effect increases as the rate of movement changes in either direction from an indefinite medium rate. This medium rate, at which the illusion should vanish, appears to depend somewhat upon the width of the slit, but is something over 4.9 cms. per sec. for slits 5 and 20 mm. wide.[1] It is interesting to notice also that the mean variation of the estimates increases as the slit is made narrower, showing that the subjects vary more among themselves as the illusion becomes more marked. These relations accord with Zöllner's explanation: As the slit is narrowed the opportunity for estimating the rate becomes less and the possibility of illusion is increased; as the rate varies from a certain medium rate it is more apt to be misjudged; as judgment becomes more difficult individual variations are more apt to occur.[2]

It may be asked, however, whether there is any other evidence than that furnished by this illusion that rapid rates of movement are underestimated and slow rates overestimated. In reply it may be said that there seems some reason to believe that there is a general tendency to assign to ill-sensed quantities a medium rather than an extreme value, but this has not yet received the study that its importance as a psychological principle deserves.[3] But irrespective of this general principle it seems to be a fact that such tendencies are active in our judgments of rate of movement, as is strikingly shown by an analogous experiment in the field of passive touch, where erroneous judgment seems to be the only possible explanation. The experiment is given by Loeb in his paper on the Tactual Space of the Hand, and is in the last degree simple.[4] A string is drawn, at different rates of speed, between the thumb and index finger of a subject who presses it lightly and judges its

[1] All of the rates used were much less than the rate found by Lamansky for the rate of the eye's own movement—(*Pflüger's Archiv*, II, 1869, 418–422); so that the rate most correctly judged is probably not a function of the eye's own rate; unless, indeed, the eye's rate is materially slower for short movements than for long.

[2] By judgment, is here meant, of course, not full and conscious logical inference, but the same sort of perceptive inference that is used in seeing form by means of the distribution of light and shade, or distance by the size of known objects.

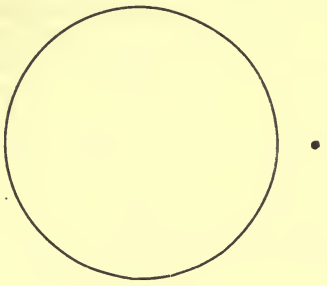
[3] Leuba some years ago noticed something similar in sense memory. *Amer. Jour. Psy.*, V, 1892–93, 382 ff.

[4] Loeb: Untersuchungen über den Fühlraum der Hand. *Pflüger's Archiv*, XLI, 1887, 107–127.

length without the use of his eyes. If the string is drawn slowly it is overestimated, if rapidly underestimated.

The explanation of the illusion by the general underestimation of rapid rates and overestimation of slow ones does not exclude the subordinate co-operation of other influences. It was found, for example, that with rapid rates the "after-image of movement" appeared clearly in the portion of the visual field corresponding to the slit. If this after-image could, to any degree, neutralize the perception of the actual movement, it might furnish a reason for the underestimation of the rapid rates.

A more certain factor is the distortion due to indirect vision.[1] Such a figure as the following will serve as an illustration:



On fixating the point the side of the circle next the fixation point will appear flattened, while the opposite side is more or less indistinct. With the figure passing alternately to and fro behind a slit, as in the hand apparatus, the flattening would occur on both sides, and the result would be a general impression of a laterally compressed ellipse. With the mechanical apparatus the flattening of the side next the fixation point may be obtained if merely a fine white thread, with a black knot for a fixation point, be hung before the travelling paper, the circle clearly seeming to change form as it passes from one side of the thread to the other. The flattening from this cause is too slight, however, to account for that observed in the original experiment, and the chief factor remains the false judgment of the rate of movement.

[1] *Cf.* Helmholtz, *op. cit.*, p. 697.

XVII. Experiments upon the Control of the Reflex Wink.

By George E. Partridge,
Sometime Fellow in Psychology, Clark University.

The best description of the problem of the following study is the incident that suggested it. A party of visitors was standing before one of the snakes' cages in Central Park, New York, watching the cobras strike against the glass. One of the party noticed that every one jumped back when the snakes struck. After their attention had been called to the involuntary movements several tried to hold the face near the glass and to prevent the reflex start, but none could control it. Doubtless with sufficient practice all or nearly all would have succeeded, but the psychophysical problem remains of how they would have attained their success—a problem of obvious importance for both psychology and pedagogy. After considerable preliminary experimenting the control of the reflex wink was finally selected as presenting the same general problem, and special apparatus was devised for exciting it. The first arrangement was as follows: The subject was seated with his forehead and chin supported by a suitable head rest. Close before his face was brought a framed piece of thick plate-glass about six by eight inches in size. On the back side of this glass and attached to the lower side of the frame was a small rubber-faced wooden-headed hammer which, when released from a catch under the control of the experimenter, was swung suddenly upward, and struck the glass about the level of the eyes of the subject. With the instrument in this form experiments were made on several members of the university and others. In a later form of the instrument, however, the head rest and glass plate were both attached to a graduated steel rod (supported on legs and standing on a table) so that the glass and striking apparatus could be set at any required distance from the subject, while the distance could be read in centimetres. The subjects generally knew the nature of the experiment to be made upon them, and were simply requested to refrain from winking.[1] In the experiments on school children, made with the revised instrument, a

[1] [The stroke of the hammer against the glass was, of course, by no means noiseless, and there was also a little tremor and rattle of the apparatus attending the blow. These must not be neglected in estimating the results of the experiments; indeed, it seems to me that the vision of the swiftly moving hammer was, perhaps, a less important factor in producing the wink than the sound of its stroke on the glass. E. C. S.]

card placed some distance away and at about the height of the subject's eyes, was used as a fixation point.

From the nature of the experiment the operator was obliged to judge for himself not only whether a wink had taken place, but also, after the subject had ceased to wink, whether the control was fairly perfect or merely temporary. In the earlier cases in the schools a good many hammer-strokes were given after the winking had ceased, but as the operator became more expert in recognizing the signs of easy control, the number of such extra tests was decreased. In no case, however, was the testing ended till the subject had been able to inhibit several winks in succession, with the appearance of being able to continue the inhibition indefinitely.

In the experiments with the university men it was soon discovered that there were the greatest differences among normal adults in the power of control of the wink. The earlier subjects were tested with the glass close to the face and without a special fixation point. The lever was released at fairly regular intervals, but of course without warning. Some were able to control the reflex movement after four or five trials and during a long series there was either no trace of movement of the eyelids or only a very slight twitching, unless there was great variation in the intervals between the stimuli; while others were unable to inhibit the reflex even after long practice.

Two subjects who had difficulty in controlling the movement were given long series of tests in order to study the method of control, and its gradual perfection. Both subjects were men trained in psychological work but of nervous temperament. Subject A. was given a series of twenty-nine tests on alternating days, fifty trials in each test. During the first four days no winks were inhibited, and oftentimes the subject winked three or four times after a single hammer stroke. The course of improvement from day to day is shown by the following figures, which give the number of cases in each group of fifty trials in which the wink was inhibited: 0, 0, 0, 0, 5, 6, 0, 6, 11, 5, 10, 10, 17, 17, 32, 21, 21, 15, 26, 16, 41, 16, 22, 23, 15, 27, 21, 32, 25. Summing these in groups of four, gives the following: 0, 17, 36, 87, 78, 102, 95. With this subject the reflex was prevented best by neglecting the stimulus altogether, and not trying to prevent the wink by contracting opposing muscles. He usually fixated some point considerably beyond the glass, and watched it attentively. Change in rhythm of releasing the lever, a peculiar rhythm, or a short interruption in the series, lessened his control. Physiological conditition seemed also to affect the results; after long continued work at his desk his control was lessened.

Subject B. had twenty-seven tests of one hundred trials each.

The number inhibited each day was as follows: 0, 0, 2, 4, 4, 0, 8, 2, 6, 4, 0, 28, 8, 4, 21, 32, 65, 39, 81, 83, 77, 92, 86, 97, 99, 88, 98. Summing these in groups of four gives the following: 6, 14, 38, 65, 268, 352. Subject B. also did best when he fixed his eyes on a distant point and was passive.

Three experiments were made to test the effect of alcohol upon control. A subject who had previously been given ten tests of one hundred trials each, in which he had averaged thirty-two inhibitions, received forty-five grams of alcohol, and five minutes later was retested. Three hundred trials were made in groups of fifty. He winked four times in the first group, but in all other trials the winks were inhibited. On subsequent normal days the subject relapsed toward his former condition. Two tests were also made with intoxicated subjects. Both these showed a decided improvement in control as the effect of alcohol.

After the apparatus had been arranged to allow variation of the distance of the glass from the subject's face the test was made upon upwards of eleven hundred pupils of the Worcester schools.[1]

The method was slightly different from that used with the adults. The child was seated with his face in the head rest of the apparatus and was given thirty-five trials with the plate at the zero point of the distance scale (about five centimeters from the eyes). If at the end of these thirty-five trials the wink was not under control the distance was increased by two centimeters and thirty-five more trials given. Then, if necessary, another thirty-five trials were given at the five centimeter mark, and afterward at 10, 15, 20, 30, 50, 80, 110, and even farther if the reflex had not sooner been brought under control. In this manner was determined for each child the number of winks, necessary before the reflex was mastered.[2] The children ranged in age from five to fifteen years, and included nearly equal numbers

[1] The writer desires to make grateful acknowledgments to the Worcester school authorities for permission to make the tests in the schools, and to the teachers and principals of the schools in which he worked for courtesies received, also to his wife who assisted in the experiments and in the work of tabulating the results.

[2] This method of computation neglects the element of distance in the final results (resting only on the number of winks), but is sufficiently exact for present purposes.

The number of winks was used rather than the number of trials, when the two did not agree, because in this way the child was given the benefit of any scattering successes occurring before he had gained complete control. A record like the following, for example—w w w w w o o o w w o o o o o o o o (w=winks, o=successes)—would stand as a score of 7 against the child when winks are counted, but as a score of 10 when trials are counted. In most cases, however, there was no difference.

of boys and girls: Boys, 584; girls, 557.[1] The following table shows the number of each age tested, together with the least number of winks necessary in any case before control was secured, the median number and the greatest number necessary:[2]

TABLE I.

Showing the Number of Winks Necessary Before the Gaining of Control.

AGE.	BOYS.				GIRLS.			
	TOTAL CASES.	LEAST NUMBER.	MEDIAN.	GREAT'ST NUMBER.	TOTAL CASES.	LEAST NUMBER.	MEDIAN.	GREAT'ST NUMBER.
5	55	1	38	218	52	0	40.5	286
6	53	1	22	199	53	1	27	171
7	48	1	4	326	55	1	13	175
8	50	0	3.5	127	50	1	17.5	378
9	51	1	3	191	52	0	6	315
10	48	0	3	233	49	0	9	291
11	52	0	2	140	47	0	4	248
12	55	1	3	69	53	0	23	335
13	58	0	2	81	55	0	4	221
14	67	0	1	261	54	1	3	325
15	47	0	1	71	37	1	2	105

The table shows a gradual improvement with increasing age, most marked in the first four or five years, an index probably of growing control of the muscular system in general during these years and especially of the reflex mechanism. The improvement is both more marked and more uniform in the case of the boys than the girls, the reason for the difference lying probably in the fuller neuro-muscular training which the average boy receives from his freer life. The most marked deviation from uniform progress is in case of the girls of twelve years. The difference seems too great to be merely accidental, and yet the writer has been unable to discover a satisfactory explanation. That it was not due to the general conditions of the experiment seems clear from the relatively small difference in the case of boys of the same age. If the results are treated by averages instead of by medians the same general relations are obtained, though the irregularities are of course differently

[1] In getting the ages of the children no account of the months was taken. The age called "five" therefore extends from the fifth to the sixth birthday, and, similarly, that called "six" from the sixth to the seventh birthday, and so on.

[2] The median number is found by arranging all the cases in order, according to the number of winks recorded, and picking out the middle number in the series. When the number of cases is odd, some particular number will be found; when it is even, the average of the two numbers nearest is taken instead.

distributed. The average number of winks for the 584 boys irrespective of age is 19, and for the 557 girls 34.

Table II is arranged to show the distribution of cases according to success in controlling the wink. The whole number of cases for each age has been divided into eight groups according to the number of winks made before complete control was secured. The first includes all who winked four times or less, the second those who winked between five and nine times inclusive, the third those who winked between ten and nineteen times, and so on, till in the last group are found those who winked 300 times or more. These figures have finally been reduced to percentages for easier comparison. *B* in each case stands for boys and *G* for girls.

TABLE II.

Showing Distribution of Cases According to Success in Controlling the Wink.

AGE.		TOTAL CASES.	0–4 WINKS.	5–9 WINKS.	10–19 WINKS.	20–49 WINKS.	50–99 WINKS.	100–199 WINKS.	200–299 WINKS.	300–399 WINKS.
5	B	55	20.	10.9	12.7	20.	23.6	7.2	5.4	
	G	52	11.5	9.6	11.5	19.2	26.9	17.2	3.8	—
6	B	53	24.5	15.0	9.4	22.6	15.0	13.3	—	—
	G	53	20.6	16.9	9.4	24.5	18.9	9.4	—	—
7	B	48	56.2	8.3	8.3	18.7	4.2	—	—	4.2
	G	55	32.6	12.6	9.0	18.1	18.1	9.0	—	—
8	B	50	60.	12.	4.	6.	14.	4.	—	—
	G	50	34.	8.	10.	12.	32.	2.	—	2.
9	B	51	62.7	13.7	1.9	11.7	5.8	3.9	—	—
	G	52	46.1	13.4	5.7	13.4	13.4	3.8	1.9	1.9
10	B	48	66.6	12.5	2.0	12.5	2.0	2.0	2.0	
	G	49	36.8	14.2	8.0	8.0	24.5	6.1	2.0	—
11	B	52	75.0	1.9	11.5	7.6	1.9	1.9	—	—
	G	47	53.0	6.3	—	16.9	10.5	8.4	4.2	—
12	B	55	65.4	10.9	5.4	14.4	1.8	—	—	1.8
	G	53	36.0	3.8	7.6	32.2	13.2	3.8	1.9	1.8
13	B	58	75.8	6.8	3.4	10.3	3.4	—	—	—
	G	55	56.3	3.6	5.4	21.8	7.2	3.6	1.8	—
14	B	67	76.1	4.4	2.9	4.4	9.0	1.4	1.4	—
	G	54	55.5	7.4	5.5	18.5	7.4	1.8	1.8	1.8
15	B	47	76.5	6.3	2.1	10.6	4.2	—	—	—
	G	37	70.2	10.8	2.7	10.8	2.7	2.7	—	—

The table shows very well the proportion of those who had difficulty in mastering the tendency to wink, and also the dif-

ference between the boys and girls. The actual number of boys in the first group (four winks or less) is 351, in all other groups 233; of girls in the first group 225, and all other groups 332. As in Table I the boys make the better showing, though individuals of both sexes are found in all the groups.

The children were tested partly in the forenoon and partly in the afternoon, but such differences as appear in the averages do not bring out any certain relation between time of day—to which fatigue might be supposed to be roughly concomitant—and the ability to control the wink. There seems also to be no marked relation between ability to control the wink and ability to take high rank in school work. Special tables prepared to test this relation are quite equivocal.

With the thought of discovering some relation between inability to control the wink and general "nervousness," the teachers were asked to indicate the children regarded by them as especially "nervous." Thirty-six boys and forty-seven girls were thus indicated. When the position of these cases is looked for in the classification of Table II it is found that sixteen of the boys and seventeen of the girls belong to the groups winking four times or less, of which groups they constitute 4.5 and 7.5 per cent. respectively. The remaining twenty boys and thirty girls winked five times or more and constitute respectively 8.6 and 9 per cent. of the whole number showing that degree of control. It would appear therefore that a boy described as "nervous" is rather apt to have difficulty in controlling the wink, but that a girl so described is but little more likely to have difficulty than one described as normal.

A similar question was asked about "dreamy and inattentive" pupils, and seventy-one boys and eighteen girls were so reported. Of the boys, forty appear in the first group of Table II, constituting 11.4 per cent. of the group, and 31 fall in the remaining groups, of which they form 13.3 per cent. Of the girls, seven appear in the first group and eleven in the remaining groups, forming about 3 per cent. in each case; showing little relation in either case between "dreaminess and inattention" and inability to control the wink. The proportion of boys and girls thus characterized by their teachers is, however, an interesting index of sex differences in school life.

The methods employed by the children to prevent the wink were various. In most cases tension of opposing muscles was first employed, the younger children sometimes tensing the muscles of the face, arms, legs and body, and even straining the fingers apart. As control was gained the muscle tensions were, of course, in general more definitely localized and lessened in degree. Many seemed to be unable to watch the fixation point, and such wandering attention was usually associated

with small power of control. In the case of some of the youngest children the effort to refrain from winking itself lapsed unless there was an occasional reminder. In a general way two types of good control could be distinguished, a nervous type with strong reflex tendencies, but equally strong control, and a stolid, fearless and somewhat inactive type with apparently less reflex excitability.

The following miscellaneous observations may also be recorded: Momentary changes in attention frequently inhibited a few winks in a series long before control was finally gained. Smiling seemed to be especially effective in temporarily inhibiting the reflex. Changes of any kind in the environment, as of some one entering the room, opening of a door, an unexpected sound, usually increased the tendency to wink, though in some cases such a distraction seemed to have the opposite effect. Some cases were observed in which, though the first few reactions were very violent, involving muscles of the whole body, final control was sooner gained than in cases where the reaction was less violent at the beginning. There appear to be great differences also in the rapidity of the wink, the eye being closed so rapidly in some cases as to make observation difficult, while in others the closure was noticeably slower.

In concluding, the writer may say that he feels that he has barely broken ground upon a subject of very great interest, and that the method here employed, or some modification of it, can yet be made to yield most interesting results in several other directions.

THE EQUIPMENT OF A PSYCHOLOGICAL LABORATORY.

By E. B. TITCHENER.

In *Mind* for July, 1898, I published a paper, entitled "A Psychological Laboratory," in which I gave a brief account of the plan, resources and aims of the Cornell laboratory.[1] Reference was made in the paper to an 'ideal' psychological labor-

[1] A few remarks supplementary to this paper may be made here. (1) We have found it necessary to exclude blackboards, however patent the writing chalk employed, from all rooms but the lecture and work rooms. The chalk dust is inevitable, and extremely penetrating. (2) All floors but one, throughout the laboratory, are of soft wood, oiled. The exception (hard wood, varnished) has proved unsatisfactory. (3) The dark-room lantern window (p. 319 of the *Mind* article) has been cut, and the arrangement works very well. (4) The direct current leads (p. 319) have been extended to five more rooms. (5) In the *Psychological Review* for November, 1898, Professor Cattell offers objection to some of our arrangements. Thus, he regards the "estimate of $300 annually for current expenses" as "rather extravagant." The objection is surely based upon a misunderstanding. All that my paper says (pp. 326-7) is that it is unsafe to begin the working year with a less sum than $300 in hand,—unsafe to have anticipated the year's income by purchases to the amount of more than $300; while it expressly states, further, that whatever remains at the end of the year goes to the procurement of research instruments. Probably the term 'current expenses,' though carefully safeguarded, proved misleading. Again, Professor Cattell urges the advantage, for research, of small closet-like rooms. Here I heartily agree with him, and, indeed, had previously introduced the feature into some of the lesser laboratories that I have helped to plan. We have, moreover, repeatedly canvassed the question of such rooms for the Cornell laboratory. Unfortunately, the functions of the laboratory are such as to preclude the required subdivision. Again, there *is* an advantage in "setting up all the work on vision in one room"—an advantage so obvious that I am surprised at the objection. The coloring and lighting of the room alone, *e. g.*, would justify the procedure. Again, the objection that a "flock of twenty students" must be driven successively into several rooms presupposes that all students in the drill-course are performing the same experiment at the same time. I should regard this as a mistake, whether considered from the student's or the instructor's point of view. It is not our method. Lastly, the objection that the smell and taste room "is not needed for an hour's instruction in the course of the year" seems to me woefully to underestimate—and the underestimation is not uncommon among experimental psychologists—the place of these two senses in a course of laboratory work. Our taste and smell room is occupied as often and as long as any other of the rooms used in the drill-course.

atory, and to the necessity of our having, some day or other, 'special buildings' for the housing of our instruments. I also expressed the hope of issuing, within a year or two, "a pamphlet containing a full list of the pieces that we [at Cornell] possess, with makers and prices, and stating briefly the results of our experience with them." Although the laboratory is not yet completed upon the twelve-room basis, and although the various schemes thought of for an ideal laboratory have not yet matured into anything that could be put into an architect's hands, it still seems worth while, in view of the interest that the preliminary discussion has aroused, to print our inventory as it stands, and to outline the general conclusions that we have reached concerning the laboratory of the future.

I. *Suggestions towards the Plan of a Psychological Laboratory.* The psychological laboratory should be conceived of as a three-story building, with attics and basement. On the ground floor I should place first, to the right, the large auditorium, a room capable of seating, say, 300 persons. This room should be accessible by a special outside stairway, and also by a passage-way behind the lecturer's table. Across this passage-way should lie the museum room, a room devoted to the display of historical instruments, the storage of the demonstration-pieces required for lecture courses, and the safe-keeping of all apparatus not actually in use in the laboratory. The plan of leaving instruments, that are now lying idle, in the places where they were last used, seems to me to be bad even in a research laboratory, but doubly bad in a teaching laboratory. It relieves the student of the wholesome labor of taking-down and casing, and it inculcates a general slovenliness and lack of method in experimental work.—An elevator should run up and down from the museum room.

The left-hand portion of the ground floor would then contain the library; a seminary room, with the Director's office opening into it; and, if space allowed, a general writing-room. This last is a room in which talking is permitted, and which students would utilize for the writing-up of experimental records immediately after the taking of an experimental series.

The second floor represents the drill-laboratory. For this I can think of no better plan of arrangement than that which I have tried to follow in my own laboratory. For optics, there should be two rooms, light and dark, facing south and north respectively, and the latter divided into antechamber and inner room. For acoustics, there should be one large room, connected directly with a small, dark and (so far as is possible without special construction) sound-proof chamber. For haptics, there should be a moderately sized room, devoted to work on cutaneous pressure, temperature, and pain, and a larger

room for investigations of the movement perceptions. Taste and smell should each have a small room, the latter tiled or glazed, and so situated that ventilation is easy and does not involve the opening of doors or transom-windows into the building. There should, further, be a clock-room, for the time-registering instruments and their controls; and a large room for the investigation of the bodily processes and changes underlying affective consciousness (pulse, breathing, muscular strength, involuntary muscular movement, bodily volume). It would also be necessary, I imagine, to have on this floor one or two small lecture-rooms, and private rooms for the instructors.

The third floor represents the research laboratory. The main feature of this would be a group of a dozen or twenty cells, large enough to take ordinary research apparatus and two persons, arranged round a common court or vestibule. There should also be a series of half-a-dozen small dark rooms (optics). I am not certain whether an attempt should be made to build an absolutely sound-proof acoustics room. There are grave mechanical difficulties, over and above the difficulty of ventilation, in the way. Moreover, recent work has shown that we attend to a given stimulus better if we are under a slight 'distraction' than we do if all distractions are ruled out of the experiment. Unless, then, the sound-proof room be itself an object of investigation,—unless we desire to know, for some definite reason, what consciousnesses occur under soundless conditions,—I incline to doubt the advisability of including this room in the scheme of the laboratory. On the other hand, the acoustics quarter should certainly be isolated by a wide passage-way from the rest of the floor, and by double ceilings from the floors above and below. The remaining space upon this floor would be filled by the clock room, a couple of large rooms kept free for such researches as demanded bulky apparatus (static sense, *e. g.*), and the private laboratories of the officers of instruction.

The attic space could be used for photography, for experimental work upon the smaller animals, and for general storage. The basement would contain the laboratory workshops, and rooms for experimental work upon larger animals. At one corner of the building, and separated by the workshops from the animal quarter, there should be a tiled room for research work in olfactometry.[1] The elevator would pass from the workshops through the museum room to the open court of the third floor.

Such, in the very barest of outline sketches, is my plan for

[1] I am very doubtful as to the position of this room, essential as the room is. Perhaps it should be placed upon the third floor.

the 'ideal' laboratory. Crude as it is, it may, perhaps, serve as a basis for future discussion. Experimental psychology is advancing so steadily along the beaten paths, is developing so many new branches, and, above all, is holding out so bravely against pedagogical and philosophical attack, that the realization of a laboratory on the scale indicated can but be a matter of time.

II. *The Equipment of the Cornell Laboratory.* The following list shows the resources of the Cornell laboratory at the present time. The classification is, to some extent, arbitrary; one and the same instrument may play a part in half-a-dozen different investigations. Where two names follow a number, the first is the name of the inventor, the second that of the manufacturer. In no case does the price given include carriage. All the pieces listed have been tested in the laboratory, either in research or in drill-work; and we are ready, upon personal application, to give the results of our experience with any of them.

A word of caution may, however, be in place here. Existing psychological laboratories bear upon them, very plainly, a personal and individual mark. We shall presently shake down into some sort of uniformity; but at present the range of variation is wide. Hence it will be well for intending purchasers to consult with the directors of two or three laboratories, rather than with one only. For example: the Hering indirect-vision color-mixer, a piece which is hardly ever out of use in the Cornell laboratory, is not used at all in certain other of the larger American laboratories which possess it. So the Ellis-Helmholtz harmonical, an apparatus of capital importance in our eyes, receives but a slighting mention in a recent paper by the Director of the Yale laboratory. On the other hand, I have seen the Baltzar interrupter-clock playing a much larger part in general laboratory economy than it does at Cornell. It will not be entirely expedient, then, to trust to the experience of a single university, unless the course of instruction there given is to be pretty closely followed. With this preface we may proceed to the list itself.

A. Physiological and Psychological Acoustics.

I. Anatomy and Physiology of the Auditory Organ.

1. Large clastic model of human ear. Auzoux. Fr. 200.00
2. Two large plaster models of internal ear of man. Steger. Mk. 20.00
3. Mechanical model of drum-skin and ossicles. Helmholtz. Jung. Mk. 50.00

See also H, III and IV.

II. Auditory Sensation: Intensity.

4.	Acoumeter. Politzer. Meyrowitz.	$2.75
5.	Triple fall-phonometer. Titchener. Willyoung.	$50.00
6.	Quadruple sound-pendulum. Titchener. Francis.	$100.00
7.	Brass piston-whistle for demonstrating proper tone of auditory passages. Vs. 1,024-4,096, in semitones. Willyoung.	$5.00

III. Auditory Sensation: Quality and Clang-tint.

8.	Model of piano key-board, with attachments showing direct clang-relationship. After Mach. Made in Ithaca.	$3.00
9.	Collection of instruments for study of clang-tint: 5 mouth-harmonicas, 1 pan-pipes, 3 jewsharps, 3 whistles, 1 bagpipes, 3 ocharinas, 2 oboes, 3 cymbals.	$7.50
10.	Bellows-table, with regulator, wind-chest and key-board for 13 pipes. Koenig. Kohl.	Mk. 400.00
11.	9 open wooden pipes, with manometric attachments, for use with above: c-c^1 (c^1 duplicated). Koenig. Kohl.	ca. Mk. 60.00
12.	Wind-chest with 2 valves, standard for 2 manometric flames, and rotating mirror. Koenig. Kohl.	ca. Mk. 120.00
13.	9 galvanized iron open pipes: c^1-c^2. Made to order.	$10.00
14.	Bellows-table for 3 reed-boxes. Appunn.	Mk. 120.00
15.	Reed-box, vs. 512-1024 (unit of diff. 4 vs.). Appunn.	Mk. 350.00
16.	Reed-box, with musical intervals, 400-800 vs. Appunn.	Mk. 150.00
17.	Reed-box, giving 9 overtones of C of 64 vs. Appunn.	Mk. 70.00
18.	Reed-box, C of 64 vs. Appunn.	Mk. 24.00
19.	Harmonical, giving 24 overtones of C of 64 vs., and 16 of c of 128 vs. Ellis. Moore.	£10.0.0
20.	Square piano. Bought in Ithaca.	$100.00
21.	Differential sonometer, with key and weights. Marloye. Koenig.	Fr. 112.00
22.	Simple sonometer, with weights. Gillis & Gleeson.	$3.75
23.	12 forks on resonance-boxes: c-e^3. Koenig.	Fr. 485.00
24.	4 forks on resonance-boxes: d^1-b^1. Koenig.	Fr. 140.00
25.	a^1 fork on resonance-box, official French standard. Koenig.	Fr. 35.00
26.	2 c-forks, 128 vs., with riders. Appunn.	Mk. 70.00
27.	4 forks (c^1, e^1, g^1, c^2) on resonance-boxes. Appunn.	Mk. 70.00
28.	7 forks (800-801 vs.) on resonance-boxes. Appunn.	Mk. 96.00
29.	33 forks (2,048-49,152 vs.). Appunn.	Mk. 170.00
30.	11 forks (2,000-45,000), with sliding resonator and ear-tube. Kessel. Appunn.	Mk. 60.00
31.	c^2 fork (512 vs.). Blake. Meyrowitz.	$1.50
32.	'Universal' fork, giving semitones. Ziegler.	$1.10
33.	2 c^2-forks. each	$ .25
34.	2 a^1-forks. each	$ .30
35.	Large fork, 16-25 vs. (C_2-G_1). Koenig.	Fr. 300.00
36.	8 forks, 3,840-4,096 vs. (b^4-c^5), in case, with tripod-stand. Koenig.	Fr. 340.00
37.	Electro-magnetic fork. c^2. Koenig.	Fr. 100.00
38.	Electro-magnetic fork, wet contact. 50 vs. Petzold.	Mk. 80.00
39.	Electro-magnetic fork. 50 vs. Chicago Laboratory Supply Co.	$20.00
40.	Electro-magnetic fork. 100 vs. Koenig.	Fr. 100.00

41. Electro-magnetic fork. a^1. Kohl. Fr. 35.00
42. Electro-magnetic fork. c^1. Kohl. Fr. 40.00
43. 13 wire forks, 8-56 vs., on resonance handles. Appunn. Mk. 130.00
44. 14 cylindrical resonators. Koenig. Fr. 380.00
45. 13 Quincke's tubes. Ziegler. $2.00
46. Apparatus for continuous tone-change, table, 2 cylinders, variator, 4 flasks, compressed air-tank, air-pump. Stern. Oehmke. ca. $100.00
47. Galton whistle. Koenig. Fr. 20.00
48. Tone-tester (differential pitch-pipe). Gilbert. Willyoung. $6.00
49. Siren, with four rows of holes and counter. Dove. Kohl. Mk. 85.00
50. Pendulum, with small fork, for demonstration of tonal after-image. Sanford. Willyoung. $16.00
51. 3 bows, set of piano-hammers, rubber-headed mallet, duplicate rubber hammer, etc., for actuating forks. $5.00
52. Steel vibrator, 4-24 vs. Appunn. Mk. 15.00
53. Xylophone, 2 octaves; with four strikers. $1.50
54. Electric phonograph, with 6-way tube, brass horn, speaker, recorder, 16 records, 24 blank cylinders, etc. Edison. Nat. Phonograph Co. $90.00
55. Foot-bellows for actuating galvanized iron pipes. Eimer & Amend. $8.00

IV. Auditory Perception, Memory, etc.

56. 2 simple metronomes. Petzold. each Mk. 7.50
57. Simple metronome. Willyoung. $3.75
58. Metronome with mercury contacts. Kronecker. Petzold. Mk. 36.00
59. Interrupter-clock, cased. Baltzar. Zimmermann. Mk. 170.00
60. 2 telephone snappers (pony receivers). Queen. each $ .90
61. Time-sense disc (Meumann, old pattern), with attachments to Petzold kymograph. Zimmermann. [New pattern: Mk. 280.00]
62. 4 (old pattern) and 6 (new pattern) contacts, with 4 contact-radii, for time-sense disc. Zimmermann. each Mk. 10 to 21
63. Localization of sound apparatus. Titchener. Michigan App. Co. $16.00

V. Charts, etc.

64. 2 modulator charts. Silver, Burdette & Co.
65. 2 charts, showing differences of temperament and vibration ratios of medical intervals. Made in Ithaca. Framed.
66. Chart to illustrate Ellis Harmonical. Framed.
67. Tableau général des nombres des vibrations de la série des sons musicaux. Koenig. Framed.

See also H, IV.

B. Physiological and Psychological Optics.

I. Anatomy and Physiology of the Visual Organs.

1. Large clastic model of human eye. Auzoux. Fr. 75.00
2. Ophthalmotrope. Helmholtz. Krille. Mk. 64.00
3. Two dissections of eye of bullock.

4. Test-cards for astigmatism. Green. Queen. $5.00
5. Test for acuity of vision. Thomson. Queen. $1.50
See also H, III and IV.

II. Visual Sensation: Intensity.

6. Working model of photometer. Bunsen. Gillis & Gleeson. $1.70
7. Large photometer. Bunsen. Made in Ithaca. $20.00
8. Spectrophotometer. Cambridge Instr. Co. £15.0.0
9. Episkotister. Krille. Mk. 25.00
10. *Episkotister. Krille.[1] Mk. 15.00

III. Visual Sensation: Quality.

11. 3 electrical color-mixers. Zimmermann. each Mk. 30.00
12. 3 electrical color-mixers. Made in Ithaca. Porter motor. each $1.50
13. 3 clock-work color-mixers. Krille, new model. each Mk. 75.00
14. Electrical color-mixer, adjustable during rotation. Marbe. Zimmermann. Mk. 240.00
15. Indirect vision color-mixer. Hering. Rothe. Mk. 147.00
16. Mechanical demonstration color-mixer. Wundt. Krille. Mk. 140.00
17. Electrical demonstration color-mixer. Elbridge El. Co. $30.00
18. Color-mixer. Lambert. Made in Ithaca. $3.00
19. Pseudoptics. Münsterberg. Bradley. $5.00
20. 24 doz. color discs. Hering. Rothe.
(1) 11 cm. diam., per doz. pf. 30 to 65
(2) 20 cm. diam., per doz. pf. 80 to Mk. 1.90
21. 12 doz. color-discs. Wundt. Zimmermann. 2 sizes. Mk. 17.25
22. 12 demonstration color-discs, 60 cm. diam. Wundt. Krille. Mk. 35.00
23. Full set colored and gray papers. Bradley.
24. 100 discs, illustrating 'spectrum top.' Ives, and made in Ithaca. ca. $15.00
25. 2 doz. skeleton discs, for gelatines. Zimmermann. ca. Mk. 5.00
26. 3 sets gelatine sheets. Kirschmann. Krille, Zimmermann. ca. Mk. 12.00
27. 12 pupils' color-tops. Bradley. $ .50
28. Double-axle mechanical color-mixer. Zimmermann. Mk. 65.00
29. Spectrum chart. Framed. Prang. $1.00
30. Chart of pure spectrum scales. Framed. Bradley. $ .50
31. Standard of color. Prang. $ .50
32. Iceland spar. Ziegler. $ .50
33. Full set gray papers. Hering. Rothe.

IV. Visual Sensation: Contrast, Color-blindness, etc.

34. Demonstration after-image apparatus. Wundt. Krille. Mk. 60.00
35. Stroboscope, with 12 photographic strips. Anschütz. Kohl. ca. Mk. 21.00
36. Artificial waterfall. Bowditch. Made in Ithaca. $4.00
37. 6 double stroboscopic discs. Stampfer. Trentsensky. Fl. 3.00
38. Wall-campimeter. Ca. 4 x 2 m. Black and white surfaces. Made in Ithaca. $10.00
39. Perimeter. Badal. Queen. $17.50

[1] The asterisk denotes that the instrument is not the property of the laboratory.

40. 5 gray screens to III. 15, *q. v.*
41. Demonstration contrast cards. Made in Ithaca.
42. 6 contrast discs. Helmholtz. Made in Ithaca.
43. 500 colored paper-rings. Hailmann. Bradley. $ .40
44. Screens and discs for quantitative determination of brightness contrast. Made in Ithaca.
45. Test-worsteds for color-blindness. Galton. Cambridge Instr. Co. £3.10.0
46. 100 worsteds. Holmgren. Queen. $6.00
47. Instrument for testing color-blindness. Hering. Rothe. Mk. 100.00
48. Binocular color mixer. Hering. Rothe. Mk. 32.00
49. Simultaneous contrast apparatus. Hering. Rothe. Mk. 40.00
50. Mirror contrast apparatus. Hering. Rothe. Mk. 28.00
51. Binocular shading apparatus. Hering. Rothe. Mk. 35.00

V. Visual Perception.

52. Apparatus for testing relative legibility of words and letters. Made in Ithaca. $10.00
53. Printed words and letters for use with above. Wood. $2.00
54. Screen for demonstration of Listing's law of eye-movement. Ca. 2.25 x 3 m. Made in Ithaca. $15.00
55. Instrument for estimation of angles. Galton. Cambridge Instr. Co. £2.0.0
56. Eye-measurement screen. Münsterberg. Elbs. $22.00
57. Eye-measurement screen. Made in Ithaca. $8.00
58. Cards for optical illusion. Knox & Watanabe.
59. 6 wire-models, showing Müller-Lyer illusion.
60. Wheatstone stereoscope and telestereoscope. Sanford model. Whitney. $10.00
61. Tropostereoscope. Ludwig. Petzold. Mk. 34.00
62. Album des centres nerveux. Debierre and Doumer. Alcan. Fr. 20.00
63. Mirror pseudoscope. Stratton. Made in Ithaca. $3.00
64. Pseudoscope. Michigan App. Co. $12.00
65. Perspectoscope. Perspecto Mfg. Co. $2.00
66. Hand stereoscope. (Perfecscope). Underwood. $1.50
67. Hand stereoscope (stereoscope model). Petzold. Mk. 8.50
68. 36 stereoscopic slides, with explanatory text. Martius-Matzdorff. Eckenrath. Mk. 6.00
69. 12 stereoscopic slides, illustrating lustre. Martius-Matzdorff. Eckenrath. Mk. 3.50
70. 18 selected stereoscopic slides. Jarvis, etc.
71. 8 stereoscopic lunar photographs. De la Rue. Petzold. Mk. 3.00
72. 10 selected stereoscopic slides for study of distance in inverted landscape. Braun, etc.
73. 24 diagrammatic slides, after Wundt and Hering. Made in Ithaca.
74. Celluloid slides, for free stereoscopy. Made in Ithaca.
75. Monocular fall-apparatus. Hering. Made in Ithaca. $2.50
76. Horopter model. Ludwig. Petzold. Mk. 150.00
77. Apparatus for demonstration of Listing's law of eye-movement. Ludwig. Petzold. Mk. 30.00
78. Large horopter model. Sanford, after Hering. Clark Lab. $15.00
79. Model of field of regard. Sanford, after Helmholtz. Whitney. $30.00
80. Apparatus for perception of forms liminally different

from their background. After Leuba. Made in Ithaca. $5.00

81. Apparatus for mapping retinal circulation by entoptic vision. Made in Ithaca. $5.00

82. 30 sets blind-spot cards. Scripture. Willyoung. each $ .15

VI. Visual Association, Memory, etc.

83. Material for study of mediate association. Howe. Collected in Ithaca.

84. Material for study of problems in individual psychology. Sharp. Collected in Ithaca.

85. Drop-apparatus, exposing series of letters, etc. Jastrow. Garden City Model Wks. $12.00

86. Dark chamber, table, asbestos lantern-cover, screens, reflectors, head-rest, etc., for study of association. Partly after Scripture. Made in Ithaca.

87. 30 selected lantern-slides, plain and colored, for study of association, memory, etc. Colt, etc. $20.00

88. 20 wood models for study of memory of visual form. Made in Ithaca.

89. 3 small tanks for colored liquids (color memory). Made in Ithaca. each $1.00

VII. General Optical Apparatus and Materials.

90. Spectroscope. Société génévoise. Fr. 300 00

91. Reading telescope. Cambridge Instr. Co. £5.0.0

92. Lens of crown glass, on elevating brass stand, 5 in. diam. Queen. $11.00

93. Equilateral prism, on elevating brass stand, 5 in. length. Queen. $11.00

94. Glass prism, equilateral, with cut handles, 6 in. Ziegler. $ .60

95. Porte-lumière. Ritchie. $5.00

96. *Photographic lens. $5.00

97. Triple diaphragm, with mm. scales. Kirschmann. Krille. Mk. 45.00

98. 2 plane mirrors, ca. 40 x 25 cm. each $2.00

99. 2 sets of colored glass plates. Krille. Mk. 15.00

100. Black tubes, metal and card, with diaphragms. $5.00

101. Large cloth screens, 2 black, 2 white. $8.00

102. Photographic camera. $30.00

103. Magnesium lamp, with reflector and tape. Eimer and Amend. $3.00

104. Photographic time and instantaneous pneumatic shutter. Queen. $6.50

105. 2-in. diam., 8-in. focus, biconcave and biconvex lenses. Ritchie. $2.50

106. *12 lantern slides in case.

107. 6 small and 2 large Geissler tubes. Ziegler. $6.50

108. Dark box for above. Made in Ithaca. $1.00

109. Dark box. Sanford. Made in Ithaca. $4.00

110. Projection lantern, with oil-burner, 2 Welsbach gas burners, 2 arc lamps. Eimer and Amend, etc. $18.00

111. Criterion projection lantern, with automatic arc lamp. Colt. $112.00

112. Adjustable stand for above. Gennert, modified. $20.00

113. Ground glass screen, ca. 1 x 1.5m., with adjustable shutters, for lantern-slide projection. $18.00
114. Dark chamber, sink, ruby window, chemicals, for developing photographs.
115. Convex-concave mirror. Ziegler. $2.25
116. *Histological-mineralogical miscroscope, with accessories. Leitz. ca. Mk. 800.00
117. *Microscope lamp. Eimer and Amend. $6.00
118. *Collection of 400 microscope slides of brain, sense-organs, etc.
119. Set of drawing instruments, 2 dotting pens, drawing inks, colored crayons, charcoal points, black and white cardboard, protractors, 12 pairs dividers, limb extensions, celluloid squares and curves, 12 paper mm. scales, 15 wooden mm. scales, architects' paper, drawing blocks, cross-ruled paper, colored spectacles, ground and milk glass, etc.

C. Haptics and Organic Sensation.

I. Haptical, etc., Sensations: Intensity.

1. Pressure balance. Scripture. Willyoung. $8.00
2. Minimal weights. Scripture. Willyoung. $3.00
3. 9 weights for method of right and wrong cases. Jastrow. Garden City Model Works. $8.50
4. 16 weights. Scripture. Willyoung. $4.00
5. 30 Weights. Galton. Cambridge Instr. Co. £5.0.0
6. 2 glass funnels, with weights of shot.
7. 6 wooden cylinders for loading with shot. each $ .25
8. Wooden egg for loading with shot. $1.00
9. Set of 100 cartridge weights. Sanford. Made in Ithaca. $2.50
10. Set of 120 envelope weights. Sanford. Made in Ithaca. $1.00
11. Pressure balance. Von Frey. Zimmermann. Mk. 40.00
12. Algesimeter. Cattell. Brown. $15.00

II. Haptical, etc., Sensations: Quality.

13. 4 pressure pencils. Scripture. Willyoung. each $1.35
14. 8 pressure pencils. Made in Ithaca. each $ .05
15. Apparatus for exploring cutaneous surface. Washburn. Krille. Mk. 50.00
16. 2 atomizers for inducing anæsthesia. each $1.00
17. Menthol pencil. $ .10
18. Improved kinesimeter, with attachments and arm-rest. Hall. Yale Lab. $100.00
19. 4 temperature tubes. Scripture. Willyoung. each $2.00
20. 12 temperature cylinders. Goldscheider. Made in Ithaca. $3.00
21. 1-gal. copper vessel, fitted with two Roux regulators and 3 Friedrich burners.
22. 2 thermometers, graduated in degrees,—24 to+200° *C.* Eimer & Amend. each $1.75
23. Thermometer, graduated in degrees,—25 to+250° *C.* Eimer & Amend. $2.00
24. Thermometer, graduated in tenths of degrees,—7 to+100° *C.* Eimer & Amend. $4.00
25. Thermometer, graduated in degrees,—10 to+250° *C.* Eimer & Amend. $1.75

26. Upright physiological inductorium. Du Bois-Reymond. Petzold. Mk. 120.00
27. 1 bipolar electrode; 1 unipolar electrode; 1 plate electrode. Chloride of Silver Dry-plate Battery Co. $5.00

III. Haptical, etc., Perception.

28. Apparatus for perception of movement by the elbow. Sanford. Willyoung. $8.00
29. Set of blocks and points for filled and open space. Titchener. Krille. Mk. 10.00
30. 23 rubber strips for estimation of extent by the skin. Titchener. Made in Ithaca. $ .50
31. Interrupted-extent apparatus. Titchener. Willyoung. $20.00
32. Set of glass and rubber forms for determination of cutaneous form-limina. Major. Eimer & Amend. $5.00
33. 12 surfaces for cutaneous impression. Made in Ithaca. $1.00
34. Set of charcoal points, with sharpener, for localization experiments. $1.00
35. 4 rods, 5 handles, 2 cups, etc., for study of eccentric projection. $5.00
36. Stationary apparatus for study of eccentric projection. Made in Ithaca. $5.00
37. Rectilineal arm-movement apparatus. Münsterberg. Elbs. $45.00
38. Combined tilt-board and rotation-table. Titchener. Willyoung. $50.00
39. Set of 7 needle-æsthesiometers. Washburn.
40. 4 simple æsthesiometers. Scripture. Willyoung. each $2.00
41. Dynamometrical æsthesiometer. Griesbach. Brändli. $17.00
42. 2 bristle æsthesiometers. Von Frey. Zimmermann. each Mk. 45.00
43. 2 slide æsthesiometers. Washburn. Brown & Sharpe. each ca. $20.00
44. 2 pain æsthesiometers. each $1.00
45. Materials for study of perception of liquidity. $5.00
46. 5 frames for 'facial vision.' Made in Ithaca. $2.50
47. Steadiness gauge. Scripture. Willyoung. $6.00

IV. Anatomy and Physiology of Organ of Static Sense.

48. Dissection of semi-circular canals of pike.
See also A, I, 1, 2.

V. Charts, etc.

49. Plate of haptical instruments. From Amer. Journ. of Psychol. VI, 3, VII, 1. Framed.
50. Chart showing localization of cutaneous impressions. From Amer. Journ. of Psychol., VII, 1. Framed.
See also H, IV.

D. Taste and Smell.

1. Double olfactometer. Scripture. Willyoung. $3.00
2. 2 clinical olfactometers. Zwaardemaker. Harting Bank. each Fl. 4.00
3. Double clinical olfactometer. Petzold. Mk. 16.00
4. Standard double fluid-mantle olfactometer. Zwaardemaker. Harting Bank. Fl. 42.00

5. Metal mirror, 3 bell jars, glass alcohol-lamp, set of duplicate glass tubes, etc., for olfactometric work. $15.00
6. 18 olfactory cylinders for clinical olfactometer. Gamble. Made in Ithaca. ca. $10.00
7. 13 standard solutions for fluid-mantle olfactometer. Gamble. Made in Ithaca. ca. $10.00
8. Set of 24 fruit flavors for taste experiments. Royce. $4.00
9. Set of 30 solutions for taste experiments. Made in Ithaca. ca. $5.00
10. Set of 29 samples of essential oils, etc., for olfactory work. Fritzsche.
11. Set of 80 solutions for olfactory work. Made in Ithaca. ca. $5.00
12. Barometer. Ziegler. $8.00
13. Set of solutions for mixed tastes and false tastes (burning, pricking, etc.). Made in Ithaca. $3.00
14. Enlarging mirror. See Vision VII, 115.
15. Camel's-hair brushes, small and large phials, burettes (Bausch & Lomb), pipettes (Eimer & Amend), rubber corks, caraffe and glasses, earthenware vessels, hard rubber syringes, etc., etc. ca. $25.00
16. Enlarged photograph of tip of tongue, showing papillæ. Oehrwall. Framed. $1.00
17. Preparation of tongue of calf, showing papillæ.

E. Affective Processes.

I. Special Instruments.

1. Combined spring and weight ergograph. Cattell. Horstmann. $35.00
2. Weight ergograph. Mosso. Willyoung. $45.00
3. Tridimensional movement analyzer. Sommer. Schmidt. Mk. 85.00
4. Sphygmograph, with complete set of attachments and arm-rest. Von Frey. Zimmermann. Mk. 200.00
5. Laryngograph. Verdin. Fr. 60.00
6. Pneumograph. Verdin. Fr. 50.00
7. Pneumograph. Sumner. $2.50
8. Dynamograph. Verdin. Fr. 130.00
9. Hand Dynamometer. Collin. Zimmermann. Mk. 27.50
10. Automatograph. Made in Ithaca. $2.00
11. Plethysmograph. Lombard. Michigan App. Co. $16.00
12. Sphygmomanometer. Mosso. Verdin. Fr. 190.00
13. Plethysmograph. Franck. Verdin. Fr. 30.00
14. 2 spring balances (for dynamometry). Chatillon. Ziegler. each $1.25

II. Models, etc.

15. Model of course of emotion. Wundt. Made in Ithaca. $2.00
16. 4 masks illustrating expression of emotion. Hennecke. $5.25
17. 8 photographs illustrating expression of emotion. Framed. Soule. $1.60
18. Bust of Femme inconnue. Donatello. Caproni. $6.00

III. General (Recording) Instruments and Materials.

19. Recording chronometer. Jacquet. Verdin. Fr. 170.00

20. Large endless-paper kymograph for 9-in. paper. Francis. $120.00
21. Endless-paper kymograph, with 2 drums, clock-work movement: all accessories. Ludwig. Petzold. Mk. 900.00
22. Simple kymograph, weight attachment. Petzold. Mk. 85.00
23. Small clock-work kymograph. Zimmermann. Mk. 185.00
24. Double set of tambours. Marey. Krille. each Mk. 40.00
25. 30 writing-points (metal, glass, bamboo). Zimmermann. Mk. 13.00
26. Set of glass, metal and porcelain T-ways and Y-tubes for rubber tubing.
27. Rubber tubing, various sizes.
28. Deprez time-marker. Zimmermann. Mk. 75.00
29. Simple time-marker. Petzold. Mk. 28.00
30. Simple time-marker. Krille. Mk. 9.00
31. Clock-work chronograph, with tuning-fork and hammer controls. Wundt. Zimmermann. Mk. 1,180.00
32. Glazed paper for kymographs and chronograph.
33. Varnishing tray, etc., for smoked records. Made in Ithaca. $5.00
34. Adjustable stand for revolving drums for smoking. Von Frey. Zimmermann. Mk. 50.00
35. Triple fan-flame gas-burner for smoking drums. Chicago Laboratory Supply Co. $ .85

F. Action.

I. Special Instruments.

1. 7 vernier chronoscopes with attachments. Sanford. Whitney. $35.00
2. 2 Hipp chronoscopes, new pattern. Krille. each Mk. 280.00
3. Large control hammer. Wundt. Krille. Mk. 290.00
4. Voice-key with relay. Cattell. Krille. Mk. 102.00
5. Lip-key. Cattell. Krille. Mk. 22.50
6. Finger-key. Dessoir. Yale Lab. [Zimmermann. Mk. 32.00]
7. Five finger key. Jastrow. Garden City Model Works. $7.50
8. Fall apparatus. Appunn. Krille. Mk. 135.00
9. 2 electro-magnetic sound hammers. Wundt. Krille. each Mk. 47.50
10. Large pyramidal pendulum for light stimuli. Krille. [Improved form, Zimmermann. Mk. 480.00]
11. Stimulator, with set of rubber forms, for cutaneous reactions. Titchener. Whitney. $7.50
12. 7 simple reaction-keys. Krille. Zimmermann. each Mk. 10.00-Mk. 35.00
13. Electric-pneumatic reaction-key. Zimmermann. Mk. 35.00
14. Electric-pneumatic pen. Henry. Zimmermann. Mk. 24.00

II. General Instruments and Materials.

15. 10 commutating keys. Zimmermann. each Mk. 15.00-Mk. 30.00
16. 2 German-silver wire rheochords. Krille. each Mk. 20.00
17. Wire, various sizes.
18. 3 wall-diagrams, with text, illustrating Hipp chronoscope. Framed. Made in Ithaca.

See also Affective Processes, III. General Supplies.

G. Attention.

1. Demonstration fall-chronometer. Wundt. Krille. Mk. 48.00
2. Complication apparatus. Wundt. Krille. Mk. 175.00
3. Set of discs for fluctuations of attention. Made in Ithaca.
4. Set of photographic word-slides, for apperception. Pillsbury. Made in Ithaca.
5. Exposure apparatus. Jastrow. Garden City Model Works, $8.50

See also A, IV; B, V, VI; C, III; D; E, I, III; F, I.

H. General Supplies.

I. Electrical Outfit.

1. Simple galvanometer. Queen. $5.00
2. Telephone, with attachments. Ziegler. $18.00
3. 7 electric bells, with push-buttons.
4. Cherry voltmeter and ammeter. each $1.50
5. Current tester. Krille. Mk. 4.50
6. 24 incandescent lamps, various sizes, with receptacles, switches, etc., for resistance.
7. 7 Daniell cells. $14.00
8. 12 Leclanché cells. $12.00
9. 3 Meidinger gravity cells. Mk. 19.50
10. 3 Edison-Lalande cells. $9.75
11. 24 Fleischl cells, in cases. Mk. 100.00
12. 2 chloride accumulators. $28.00
13. 20 lbs. quicksilver. $15.00
14. Large tinned-iron rheostat. Nichols. Made in Ithaca. $3.50
15. 2-in. spark induction coil. Ziegler. $34.10
16. Sliding brass wire rheostat. Horstmann. $5.00
17. 12 doz. connectors. $12.00
18. 12 doz. binding posts. $12.00
19. Five-point switch. Queen. $ .75
20. 30-fold system of wires, connecting rooms.
21. Direct current, 110 volts, in 7 rooms; switches and glass-doored switch cases. (Day current).
22. Illuminating system, alternating current, 110 volts, in all rooms. (Night current.)
23. Crocker-Wheeler motor, $\frac{1}{6}$ H. P., 1600 r. p. m., 115 v. $22.50
24. Speed reducer. Pillsbury. Michigan App. Co. $12.00
25. Combined dynamo and motor model. Elbridge El. Co. See Vision, III, 17.

II. Mechanical and Chemical Outfit.

26. 14 standards; 11 arms; 18 clamps; 4 rubber clamps; 12 pulleys. Eimer & Amend, White, Petzold, etc. $45.00
27. 4 oil lamps.
28. 2 Bunsen burners. each $ .50
29. 4 Friedrich burners.
30. Glass-ware, various.
31. Full set carpenter's tools.
32. Gas in 5 rooms.
33. Water in 3 rooms.
34. 3 adjustable chairs. each $5.00
35. Couch. $15.00

36. 8 instrument cases; 2 chart cases; 2 battery and store cupboards.
37. Water motor. Zimmermann. Mk. 12.50
38. 2 gals. each sulphuric and nitric acid; 1 gal. each turpentine, hydrochloric acid, odorless paraffin, absolute alcohol.
39. Ether; shellac and alcohol varnish; machine oil; lamp-black; rubber cement, etc., etc.
40. Quarter-second stop-watch. $6.00
41. Fifth-second stop-watch. $6.00
42. Fifth-second stop-watch. $6.50
43. Chemical balance with weights. Eimer & Amend. $49.00
44. Cotton wool; cloth; wood for models, etc.; wood and card boxes; twine, silk; glue, paste, mucilage; oakum, waste; spare gas-pipes; leather, various sorts; wax, various sorts; cardboard instrument covers, all sizes; etc., etc.

III. Physiological and Anatomical Outfit.

45. *Case of physiological instruments.
46. Case of physiological instruments.
47. Odd physiological instruments (scissors, scalpels, etc.)
48. Large clastic model of brain. Auzoux. Fr. 300.00
49. Set of 10 brain models. Steger. Mk. 64.00
50. *Articulated skull, with restoration of ear.
51. *Series of 12 brains.
52. 12 wall diagrams (colored) of brain and sense-organs. From Wenzel, Anatomischer Handatlas. Stauffer. Framed. Mk. 16.00
53. *Epitome of cranial nerves. Rider, after Heiberg. Framed.

IV. Diagrams, etc.

54. 3 large photographs of first psychological laboratory of Cornell University. Framed.
55. Chart to illustrate metric system. Amer. Metrol. Soc. Framed.
56. Set of 50 wall-diagrams to illustrate Course in Systematic Psychology.
57. Series of 35 psychological portraits. Open Court Pub. Co. Framed. $7.75
58. Large platinotypes of Wundt and Fechner. Bellach. Framed. each Mk. 60.00
59. Etched portrait of Chas. Darwin. Hollyer. Keppel. Framed. $1.00
60. *40 frames of psychological portraits, autographs, etc.
61. Bust of Aristotle. Hennecke. $7.50
62. Portraits of Helmholtz and Donders from Arch. f. Ophthalmologie. Framed. $2.00

Various instruments, now on order or in the making, have been omitted from the above list: Nothing is said, in particular, of the series of simple pieces which is in course of construction for the writer by the Chicago Laboratory Supply Co. A special circular, describing these pieces, will shortly be issued by the firm.

PSYCHOLOGICAL LITERATURE.

Zur Analyse der Unterschiedsempfindlichkeit. Experimentelle Beiträge von LILLIE J. MARTIN und G. E. MUELLER. Leipzig, J. A. Barth, 1899, pp. vi, 233.

Probably all psychologists who are accustomed to reflect seriously on what they have experienced in judging small differences of stimuli, have felt that the usual rules laid down in the psychophysical methods for the elimination of constant errors, were treating in a very abstract and mechanical manner extremely complicated and more or less erratic processes. That like stimuli should seem to vary quantitatively and qualitatively from day to day, that periods of ease and of difficulty in comparing stimuli should follow one another intermittently, that now one order of standard and variable should be easier to 'judge' and later on the reverse order, are matters which, psychologists are beginning to feel, are not to be put aside with a reference to 'probable indisposition of reagent' or to 'some disturbances in the course of experimentation,' but are themselves subjects for investigation. That is, there are signs that psychologists are coming to feel their next concern is not with further determinations of sensitiveness to difference and with the mathematical elaborations of the psychophysical methods based on the laws of large numbers, but with the complicated psychical processes underlying the method, and a very solid and valuable expression of this feeling is to be found in this *Analyse* of Martin and Müller.

The method of right and wrong cases, or, as the authors prefer to call it of "constant differences" is the peg on which the investigation is hung; but, as stated in the preface, the object was not the massing of results for determining some "so-called sensitiveness to difference," but the analysis of the physiological and psychological factors by means of which the results themselves were determined.

Suppose in an investigation for determining sensitiveness to difference for 'hefted' weights with the usual reversal of time and space order which is supposed to eliminate time and space errors, the investigator having collected his results, should run against a summary like this :—

SUMMARY OF JUDGMENTS (p. 101).

Order I. Standard-Variable: lighter 203 times: like 479 times: heavier 214 times:
Order II. Variable-Standard: " 106 " " 561 " " 229 "

According to orthodox views of error elimination, if there is practical equality of "lighter" and "heavier" in Order I, there should be in Order II; or, if there are more "lighter" judgments in I than in II, there ought to be correspondingly more "heavier" judgments in II: but the "heavier" in I about balance those in II.

When the aim of the investigator has been to determine sensitiveness to difference he has not usually thought it necessary to discuss this condition of results, but has passed rapidly on to the consideration of the relative numbers of right, wrong and doubtful cases, to determinations of sensitiveness and thence to 'laws.' The investigation of such anomalous conditions as appear in the above summary is the main object of the present research, and the results must directly affect the validity of the method of right and wrong cases so far as it

rests on experiments with 'hefted' weights, and indirectly its validity with other kinds of stimuli. The working conditions were essentially those of Müller's earlier work with Schumann.[1] One hand was used and the judgment was referred to the second weight. The standard weight ranged from 416 to 3,221 grams. and for each standard there were usually 7 variables,—three above, three below and one like the standard. The height of lifting was limited by a taut horizontal string, and the time was determined by a metronome. The authors chose this method in preference to Wreschner's physiologically simpler arrangement, partly because they wanted to follow out Müller and Schumann's line of work, and partly because they preferred to experiment on a 'natural' every-day movement. The reagents were directed to deliver their judgments under the heads of 'larger clearly,' 'larger' 'undecided' 'smaller' and 'smaller clearly.' The discussion of the various forms of judgments tried and the reasons for adopting the above categories would form good prolegomena to some future handbook on psychophysical methods of measurement. The attitude of the reagent towards 'larger clearly' *e. g.*, was quite different from that towards 'clearly larger.' 'Undecided' comprehended all cases when reagents did not feel sure of a 'larger' or 'smaller,' together with the comparatively few cases of a positive conviction of 'like.'

The deviations from a symmetrical grouping of results as shown, *e. g.*, in the above 'summary of judgments,' are due to factors in the process of comparing which are analyzed under the heading of "Anomalous differences in the numbers representing right judgments." The first of these "anomalous differences" is shown in the fact that more right judgments are given when the variable comes second than when it comes first (Order I); this holds good whether the variable is greater or less than the standard. The influence producing this effect is termed the general tendency of judgment; it is present in all reagents, and comes from the prevalence of *absolute* impressions of heaviness or lightness,—*i. e.*, impressions in which no comparison with another definite weight takes place any more than when in lifting a book or letter we call it heavy or light. The heavier the variable the more active the tendency. The evidence for the existence of such absolute impressions comes, of course, from the reagents who in many cases were not aware of a trace of a comparison with the standard weight. One reagent remarked: "If I decide that a weight is clearly greater or smaller than another, the judgment does not rest on a difference in the weights, but chiefly on the fact that the weight appears to me in a general way very large or very small." (p. 45.) Under these conditions one might expect a tendency in case of the order variable-standard to call the variable lighter or heavier before the standard was touched; this was the case with some reagents, and the tendency rather increased than diminished with practice. With many reagents it was found that the judgments were given with the maximum feeling of ease and security when the variable followed the standard. These and similar statements the authors hold are only to be explained on the theory of 'absolute impressions.'

Another irregularity noticed in the distribution of right cases is termed the anomaly of type. Some reagents gave more right judgments when standard $>$ variable, and others when standard $<$ variable. The first class was of the positive type:—it was made up of five men and one woman—that is of comparatively muscular individuals, the one woman being well exercised in household work. The second class was made up of five women and one man, that is of comparatively

[1] Müller und Schumann: Ueb. d. psycholog. Grundlagen d. Vergleichung gehob. Gewichte. *Pflüger's Arch.*, XLV, 37.

weak individuals, the one man having a slight muscular development. These conditions, along with the tendency to judge from absolute impressions, readily explain the anomalies of type. The strong or positive type, *e. g.*, would more easily get an absolute impression of "less" than of "greater," consequently would give more correct judgments when standard > variable. Obviously the influence of a type will work with the general tendency of judgment in one part of each order of standard and variable and against it in the other part.

The clear cases noted above under the headings of "larger clearly" or "smaller clearly" are obviously those in which the effects of absolute impressions should be most prominent, for in such cases there would be the least disturbance of conviction by comparison. In 'clear cases,' therefore, the type should stand out more conspicuously than in the total judgments. As a matter of fact the type can usually be determined by reference to the 'clear cases' when it is hidden in the total summaries. On page 231 the authors express the opinion that such absolute impressions probably take place with other kinds of sensations, in which case the accuracy of judgment must be fairly independent of the time-interval between standard and variable. In some experiments with clangs, carried out a few years ago,[1] to get some insight, if possible, into the nature of the so-called memory-image, which plays so heavy a part in the explanation of memory experiments, the writer found that for time-intervals from 1 sec. up to 60 sec. there was but little falling off in accuracy of judgment with increase in time for differences of stimuli (8 and 4 vibrations). Finding, moreover, that judgments were delivered with more ease and a feeling of security for time-intervals filled with absorbing distraction, and that the distraction did not strongly or regularly affect the number of correct judgments, the experimenters came to the conclusion that for the most part no comparison of standard and variable took place; *i. e.*, that the judgments were based on 'absolute impressions' as Martin and Müller term them.

As the direction of general judgment and type tendencies depend on the time order of the stimuli, they may be considered as parts of the general or resultant time error, though unlike the ordinary or Fechnerian time error they are not eliminable. The authors find in their results, however, an error which amounts to a positive or negative addition to the difference between standard and variable, according to their time order. They call this the Fechnerian time error, and attribute it to physiological causes — either fatigue or excitation, according to the strength and disposition of the reagent. According to its sign this time error may act with or against the general tendency of judgment, and with or against the type. The physiological nature of the error is evidenced by the fact that while the positive type may show either kind of Fechnerian time error, positive or negative, the negative type shows only the negative error.

These three factors — the general tendency of judgment, the type, and the Fechnerian time error together — will explain the contradictory figures given above, *i. e.:*

Standard = 440 grams; Variables = 470, 460, 450, 440, 430, 420, 410 grams.

	Lighter.	Indiff.	Heavier.
Time Order I.....	203	479	214
Time Order II.....	106	561	229

If the 'clear' cases should be separated out from these judgments, the

[1] *Vide*, Angell and Harwood: Experiments on Determination of Clangs, etc., *Am. Jour. Psychology*, XI, 1899, 67 ff.

positive type would appear, *i. e.*, more right cases would be found in these clear judgments when standard > variable than under the reverse condition. Distributing to each of the seven values of the variable the actual number of judgments falling on that variable, classified according to the judgment categories of "heavier clearly," "heavier," etc., one gets a table showing the direction of the Fechnerian time error. For instance, with standard and variable alike (Difference D = o) more judments of 'larger' fell on the variable in Time Order I, and more on the standard in Time Order II. *i. e.*, the Fechnerian time error is "negative."

Accordingly, in the above summary the type and Fechnerian time error are opposed in Time Order I, so that the "lighter" and "heavier" judgments almost balance, the slight excess of "heavier" (203 : 214) indicating possibly that the Fechnerian time error tendency is slightly stronger than the type. The general judgment tendency is, of course distributed equally over both "lighter" and "heavier." In Time Order II the influence of type and time error is in the same sense, *i. e.*, towards judgments of "heavier;" and the result is a very great falling off in 'lighter' judgments.

In analyzing out these several tendencies the authors used two kinds of tables: a series of "Summaries of Judgments" similar to that given above, and another of the distribution of right cases under the several categories of judgment for each value of D (difference of standard and variable). Each kind of table brought out tendencies hidden in the other, and, what is especially valuable in so great a complication of factors, each serving, in a measure, as a check on the other.

The effect of practice also turned out to be very different from what might be anticipated. So far from the results becoming more regular with practice, they sometimes changed character entirely — a negative type becoming positive, and *vice versa*. It was shown later that a reagent's measure of conviction for delivering a certain kind of judgment did not remain the same. In general, the authors assert (p. 134) that the effects of practice are harder to determine than any other subsidiary tendency.

What part is played in these judgments by an actual comparison of standard and variable? The answer to this question is somewhat surprising. "We are by no means of the opinion," the authors say (note, p. 49), "that a comparison of weights never takes place. Those comparisons, however, which are the easiest to determine, are, strange to say, not comparisons between the standard and its variables, but a comparison between a variable which has just been 'hefted' and the variable of the immediately preceding experiment." For example, one of the reagents said: "Just as I was about to say 'greater clearly' I remembered that the preceding judgment was based on a sensation which was greater than the one just experienced, and so for the latter I merely said 'greater,'" (p. 155).

The tendency expressed in notes of this kind was investigated by means of control experiments (*Vexir-Versuche*). In a series of eight variables, *e. g.*, three were like the standard, the remaining five forming an arithmetical series, all larger, or all smaller than the standard, as the case might be. The object of the arrangement was to determine the effect of preceding impressions of "heavier" or "lighter" on the central experiments. The effect of a preceding difference producing say the correct judgment 'smaller,' was to produce a tendency towards 'larger' judgments when the standard was equal to the variable, and in general this tendency was the more marked the greater the preceding difference. For example, with a standard of 485 grams, the preceding variable 460 produced 18 'greater' judgments in the central

experiments, whilst 410 as preceding variable produced 35 "greater." As was to be expected from the above results a similar influence affected the general experiments; analysis of the data shows that judgment of the smaller values of D was influenced by preceding greater values of D.

In this case of 'indirect comparison' the comparison takes place between single perceptions; another form of 'indirect comparison' which may disturb the first is due rather to a comparison of differences, and this results in a change of criterion for any given form of judgment; if, for example, the actual differences between standard and variable are very large the reagents will, so to speak, become accustomed to a stricter criterion in applying the judgments "larger" and "smaller," so that their judgments will be given only through some very clear impression of greater or smaller. The result will be that the mistakes of judging the control experiments as 'larger' or 'smaller' will rarely be made. (p. 171.) A confirmation of this is found in Kämpfe's investigation, (*Phil. Stud.*, VIII, S. 549) in which control experiments were used. The greater the actual difference between standard and variable the less the errors of judgment in the control experiments; and the less the value of D the greater the number of errors for the cases when D = o.

Excluding errors of space order there are then, according to this analysis, no less than five possible influences at work in determining judgments on 'hefted' weights when all outer and inner conditions are made as constant as possible.

1° The general tendency of judgment, resulting in more correct judgments when the variable follows the standard.

2° Influence of the type—positive and negative.

3° Influence of the Fechnerian time error—positive and negative.

4. Influence of size of variable in preceding judgment.

5. Influence of change of criterion for delivering judgments. Of all these the only one that is theoretically eliminable is the Fechnerian time error.

A complete investigation of space errors was not contemplated by the authors. Experiments involving space errors were, however, carried out with reference to the type tendencies. It was found that either position (right or left) might be positive or negative in the Fechnerian sense.

Other interesting points developed by the experimentation were the compensation effects, on the judgments, of reference to the first or second weight, the influences of partial knowledge of the conditions of experimentation, and of the conditions affecting the time of delivering a judgment. As a whole the work contains material enough for half a dozen ordinary *Arbeits*.

But despite the many factors analyzed out by the authors one rarely feels he is on shaky ground, partly because the results agree when looked at from different standpoints, and partly because the conclusions fit in with common sense views, as in the case of the unusually strong and weak types, or with tendencies which any observant psychologist has noticed in his own experience, as is the case with the absolute impressions and indirect comparisons.

In the preface, Prof. Müller states that a main purpose of the work is by means of criticism to contribute something towards dispelling the illusion that the complicated and difficult province of psychology is peculiarly that in which one can further scientific knowledge with a minimum outfit of acquirements and training. It is probably no injustice to Prof. Martin, who, as the preface states, really conducted the work, to surmise that the drastic criticism of Wreschner's

"*Methodologische Beiträge*," as well as the discussion of Cattell and Fullerton's "Small Differences of Sensation," proceed from the pen of Prof. Müller. Into these criticisms, as well as into a discussion of the support which this *Analyse* gives to Müller and Schumann's theory of 'hefted' weights, this is hardly the place to enter, as the object of this paper is to give, if possible, an intelligible résumé of a work which is as uncommonly hard to read as it is uncommonly rich in acute and sound psychological analysis.

F. ANGELL.

SOME RECENT ITALIAN PSYCHOLOGICAL LITERATURE.

By ALEXANDER F. CHAMBERLAIN.

In these brief abstracts and review-notes of recent Italian psychological literature no attempt has been made to cover the entire field, or to go into details of facts and technicalities, but simply to give in a few words some of the more important points discussed, theories advanced, suggestions made, and contributions of value added to the literature of the subjects treated. The topics considered are such as have appealed specially to the present writer.

Riddles. Dr. V. Giuffrida-Ruggeri[1] has found the "riddle," that test play of the folk, worthy a psychological study,—the foundations for such an investigation were laid long ago in the encyclopædic collections of Pitré, the *doyen* of Italian folklorists. It is in the riddle that is "poetically hidden" the wisdom of the folk-soul. The author attempts a classification of riddles, from the psychological point of view into: Descriptive, observational, instructive, emotional, imaginative, humorous. These popular riddles are a means by which we can get at "the contents of parents' minds," to a certain extent at least.

Imagination. Elsewhere[2] Dr. Giuffrida-Ruggeri discusses in rather brief fashion the "Evolution of the Imagination." Accepting the definition of Binet ("the imagination is the faculty of creating groups of images which do not correspond to any exterior reality"), he so interprets it as to exclude the traditional distinction between the "reproductive" and the "constructive" imagination, made so much of by Spencer and his disciples in psychology. It is doubtful if the so-called "reproductive imagination" is essentially different from ordinary association and memory. According to the author the evolution of the imagination is from the simply objective to the schematic, then from the schematic to the symbolic. Its course is from the primitive chaotic phantasmagoria to the symbolism that not infrequently falls a victim to involution. The history of the race and the development of the individual illustrate this evolution of the imagination. In its first stages at the beginning imagination is not very unlike the *rêverie* of a long repose. Indeed "the luxurious cycle of ancient Greek legends, a real spring-time of voluntary illusions, corresponds to what dreams are in the life of the individual, a true type of hallucinations and metamorphoses." This Greek metamorphosis is not only a transition from the known to the unknown, an extension of an anterior consciousness, but was perhaps the first classification ever

[1] Il valore psicologico dell' indovinello. Un' inchiesta sull' ideazione popolare. Riv. di Psicol., psich., e neurop., Vol. VI., pp. 1-4.

[2] L'evoluzione dell' immaginazione. Arch. per l'Antrop. e la Etnol. (Firenze,) Vol. XXVIII (1898), pp. 197-206.

made in Greece. But, although metamorphosis is the master-way of Greek imagination, there were collaterals also,—contrast, Baldwin's suggestion of contradiction, etc. The schematic reduction of a mass of legends and myths, so fruitful in the history of art represents the next stage in the folk-imagination—the banquet of Atreus, the tale of the wandering knight in the Middle Ages, are examples here. With the introduction of abstract concepts and the removal of the image, or group of images, from the sphere of the concrete, the imagination becomes symbolic.

In general, we can say concerning the evolution of the imagination: "In the great religions of classic antiquity, when the external world was reflected in the still infantile mind as in a mirror, it appears in its objective phases splendid and phantasmagorical; in the Middle Ages, when the religious feeling reached its highest paroxysm, it became schematic; lastly, when religion is in a way to become one of the many social conveniences, it turns symbolic."

The importance of the evolution of this faculty of the human mind is further emphasized by Ambrosi's[1] "Psychology of the Imagination in the History of Philosophy," a work which appeared about the same time as the article just reviewed. In his "Anthropological-Pedagogical Studies," the first volume of which appeared in 1896[2] and the second in 1898,[3] Professor Vitale Vitali discussing the resemblances and differences of a sexual sort between the school-boys and school-girls of the Romagna, devotes a section of his chapter on "Mental Constitution" to "Imagination and Association" (Vol. I, pp. 65-72; Vol. II, pp. 93-103). According to Vitali the examination of the artistic and literary productions show that women "rise through study to the comprehension of things to the reason that analyzes, that comprehends, as Legouvé says, and not to the reason that synthetizes, that creates." The drawings of the school-girls of the Romagna reveal the fact that they copy with the greatest patience and exactness; their work in general is clean, precise, but there is lacking the traits that reveal genius. Many of the boys' drawings, on the other hand, are less precise and exact, less neat and careful, but, with the few traits they possess, reveal a greater feeling for the true and the beautiful. Vitali experimented with a combination of the Dugas and Bourdon methods as to the images called up by particular words, and found that those evoked in girls were always simpler than those evoked in the boys, and always intimately associated with personality. The girls, in fact, "illustrated marvellously well the intellectual utilitarianism, that adopts the image most convenient to the ego, and not always that referring to the nature of the object recalled." Family, maternity, etc., are for them words rich in associations, the word cradle (*culla*) especially so. Out of the girls (16-20 years) interrogated as to the image suggested by the word "cradle," 29 recalled the baby; 5 the mamma; 4 the motion of rocking, etc.; 3 the crying of the baby; 2 the sleep of the baby; 10 abstract ideas: innocence, maternal affection, tenderness, purity, the happiest period of life, maternal duties, the greater joy of woman, etc. Altogether, we may say that girls have less unity, boys less precision in their imaginative productions. Like Giuffrida-Ruggeri, Vitali sees nothing in the distinction between "reproductive" and "productive" imagination, since the former, the necessary antecedent of the latter, is only memory. According to Dr. Bagli, the folklorist, whom Vitali cites, the people of the Romagna, in general, as their popular literature proves, have never soared very

[1] La psicologia dell' immaginazione nella storia della filosofia. Roma, 1898.
[2] I Romagnoli. Forli, 1896, pp. 116.
[3] Le Romagnole. Torino, 1898, pp. 126.

high on the wings of fancy, although so little of their work has been printed that one may be misjudging their ability in this direction. In the faithful imitation of the classics, the older, more naïve element of the folk-imagination has been swamped. Artistic production, too, has fallen into equal impotence—almost all the great painters of the Romagna have been, more or less, imitators. The people of the Romagna are executors of a very exact, patient, minute, subtle sort, but lack, in general, artistic inspiration, the "*scatto artistico*." Even ceramic art (Faenza is in the Romagna) is with them imitation, not invention. Music is worse off still. There is room for a good book on imagination, association, imitation, as revealed to us in this part of the Italian peninsula.

Inhibition. Professor Ruggero Oddi, of the Physiological Institute in the University of Genoa, discusses "Inhibition from the Physio-Pathological, Psychological and Social Point of View."[1] The preface is dated September, 1897, hence Colozza's[2] study of inhibition from the side of pedagogy, is not referred to, although each section of the book is provided with an ample bibliography. Oddi's general position is somewhat like that of Mercier, whom he quotes approvingly: Every thing in the organic, as well as in the inorganic world, is the result of a continuous, incessant struggle of antagonistic forces. The animal organism and the nervous system are not removed from the sphere of action of this law,—the struggle only becomes more intense, varied and complex by reason of the greater intensity, variety and complexity which characterize its life, its mode of being and appearing. The struggle of dynamogeny and inhibition, the contest of the force seeking to free and the force seeking to control or to prevent, make up the nervous life of man, no less than they do the life of the universe. Equilibrium of these forces produces inertia. Inhibition, according to Oddi, is, like dynamogeny, "a fundamental function of the nervous system, one of the antagonistic elements in the great struggle for life, a manifestation of protoplasmic irritability, of the excitability of the nervous element." The pathological side of the phenomena of inhibition is seen in such augmentations or diminutions of the powers of inhibition as result in a disturbance of the struggle of action and inaction, which is not transitory merely as such alternations normally are, but more or less permanent. In education and civilization progress has been by the transforming power of inhibition—from the child to the adult, from the savage to the man of culture, man has trodden the path of inhibition, and criminals and other social monstrosities are the failures that have accumulated by the road-side. Education thus "consists of a series of inhibitory acts tending to modify and repress the instinctive impulses of animal nature, and to habituate the nervous centers and nerve paths to preventing the passage of those stimuli promotive of harmful manifestations of anti-social instincts, just as we are wont to intercept the path of all that may result to the disadvantage of the individual." Where this development is not possible because of congenital atrophy or the arrest of development in certain parts of the nervous system, and such cases are still very numerous, we get the "born criminal," whom education can only transform from a brutal criminal into a refined and elegant one. Crime and its consorts can only be abolished by the slow growth of social well-being, material and moral prosperity, the satisfaction of physiological needs, the gradual disappearance of all inter-social hates. The social inheritance of inhibition will ultimately prevent rather

[1] L'inibizione dal punto di vista fisio-patologico, psicologico e sociale. Torino, 1898. VIII, 166 pp.
[2] Del potere di inibizione. Nota di pedagogia. Torino, 1897, pp, 128.

than suppress the criminal. As to inhibition itself we shall know its nature *per se* only when we discover the real nature of nerve elements. Colozza's book on "Inhibition," treated from the socio-pedagogical standpoint, should be read in connection with his earlier work on "Play,"[1] to which it is a pendant.

Premeditation. According to Dr. Jacopo Finzi[2] premeditation is not a special or characteristic sign of any species of murder, as is often thought, and it is self-evident that a premeditated crime is not, *per se*, more dangerous than an unpremeditated one. The distinction between the two is a matter of psychology, not of penology. While born-criminals are especially given to premeditation, it is not uncommon in occasional criminals, lunatics, epileptics, etc. An earlier writer on the same subject, Bernardino Alimena[3] had taken the view that the murderer who acts with premeditation is a particularly dangerous criminal, because premeditation is "the sign of an irreducible nature." Alimena considered that premeditation was, *per se*, a proof of the refractory character of the offender, in so far as reflexion is concerned. Certain mental affections, hypnotism, drunkenness, etc., are of great interest by reason of their influence upon premeditation.

Punishment. In his article "Considérations sur l'inefficacité de la peine chez les criminels vrais,"[4] Dr. Cesare Agostini, Professor of Criminal Anthropology at the University of Perugia, while not agreeing with the letter of Holtzendorff's declaration that "penal systems are bankrupt," comes to the conclusion that punishment, as we have it to-day is not efficacious as a represser of crime, as a protector of society—for real criminals are recidivists by nature and their anti-social instincts are not abolished but often encouraged by fixed terms of imprisonment. With occasional criminals and criminals by passion, such punishments as are now inflicted may sometimes secure amendment in the individuals through the feelings of shame and chagrin which they arouse, but this advantage is very little when compared with the depravity, degeneration and deprival of profitable and useful employment of undoubted energies and abilities which prison-life so often entails. In fact, normal individuals, who really do not need it, their own conscience serving them as corrective, are the only ones to whom punishment would be of use. Dr. Agostini is a partisan of the school of Lombroso and Ferri, and would settle the matter by perpetual isolation of the criminal in penitentiary colonies, where his labor would do some good to the community whose social and moral development made necessary his ostracism for life. Life treatment of this sort, and not fixed periods of imprisonment, is the only safeguard society can employ, short of the elimination of all true criminals by death. But Dr. Agostini, like the rest of the modern positive school, sees too much that is fixed and typical in the criminal and magnifies the hereditary factor in crime more than the evidence justifies. He sees too often the born-criminal, and the "physical basis" of crime, still believes in the "criminal brain," and is hopelessly convinced that "for every one who obeys instinctively a criminal impulse, punishment is a means of intimidation eminently useless."

Soliloquy. Dr. A. Raggi[5] has studied at the asylum in Pavia the soliloquy of 270 male and 210 female lunatics, with considerable detail

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[1] Il giuoco nella psicologia e nella pedagogia. Torino, 1895, pp. 282.
[2] Il valore psicologica della premeditazione. [Estr. d. *Scuola Positiva*]. Firenze, 1897, pp. 11.
[3] La premeditazione in rapporto alla psicologia, al diritto, alla legislazione comparata. Con diagrammi. Torino, 1888, pp. XV, 286.
[4] Rev. de Psychol. clin. et thérap., Vol. III (1899), pp. 72–78.
[5] Osservazioni e considerazioni cliniche sul soliloquio dei pazzi. Il Manicomio moderno, Vol. XIV (1898), pp. 399–423.

as to condition, time, circumstance, stimuli, etc. Aside from the clinical data, the following, among other facts, are brought out by the investigation:

1. Soliloquy, while much more common in female, is very frequent with male lunatics.

2. Soliloquy occurs both by night and by day; its absence by night is very common, its absence by day much less so.

3. Soliloquy during sleep does not seem to be more common in lunatics than in sane individuals, rather rarer in fact.

In general, the soliloquy of lunatics has essentially the same significance as their ordinary language, but it needs always to be given more attention, for it possesses characters more evident and escapes all presumption of artifice or simulation.

Collective Psychology. French writers, Tarde and Le Bon especially, have been charged with borrowing not a few ideas and suggestions from the Italian psycho-criminologists, in particular from Sighele, whose "Criminal Couple"[1] saw its second edition in 1897. Here the phenomenon of criminal association, with its unique factor of suggestion, is seen in its simplicity, if that is at all possible, and all the facts of active and passive co-operation in criminality *à deux*, double suicides, double lunacies, love-murders, infanticides, etc., are touched upon, including the interesting and important folk-idea of the *succubi* and the demon-possession of the dark ages in Europe and elsewhere. The author holds, with Morselli, Ferri and others, that suicide and homicide follow contrary laws of development, and that, in love, suicide came first, then homicide, for which view there is not a little evidence to be gained from the study of primitive peoples, with whom love and its woes are much more common than most of us have thought.

That the "crowd," so much be-written of late years, by the writers of the Italian and French schools, Sighéle, Tarde, LeBon, and others, is not so black as it has been painted may be read in Pasquale Rossi's "Mind of the Crowd,"[2] who exploits some of its virtues. Not infrequently crowds display altruistic and anti-criminal feelings, impulses, etc., and their pacific labors are by no means uncommon. However, the evidence is hardly enough to enable us as yet to scout the old saying: *Senatores boni viri, senatus mala bestia.*

Over against the crowd we may set the vagabond about whom quite a respectable mass of literature is growing up, as witness the essay of Cavaglieri and Florian, and the article of Donati.[3] The latter describes, with some detail, a "vagabond mystic;"[4] a fellow, who, in the early Christian days, or even in the Middle Ages, would have been a sort of saint, but is now classed among the degenerates, with weak moral sense, exaggerated mysticism, and ambulatory delirium.

BOOK NOTES.

G. S. H.

Die Wanderungen der Tiere, von WILLIAM MARSHALL. Seele and Co., Leipzig, 1897. pp. 24.

This is an interesting lecture describing very briefly the migratory habits and range of many species of birds and animals.

[1] La coppia criminale. Studio di psicologia morbosa. Torino, 1897, XVI, 216 pp.
[2] L'animo della folla (Appunti di psicologia collettiva). Cosenza, 1898, XIII, 286 pp.
[3] I vagabondi. Torino, 1897.
[4] Un caso di vagabondaggio mistico. Riv. Sperim. di Fren. Vol. XXIII (1897), pp. 160–173.

Die intellektuellen Eigenschaften (Geist und Seele) der Pferde, von F. A. ZURN. Schickhardt und Ebner, Stuttgart, 1899. pp. 55.

This is the eighth in a series of hippological treatises and considers many topics from skull capacity to the horse's power of observation, memory, judgment, knowledge of place, tone and color, fright, friendliness, or spite towards certain men or animals, play, pride, grief, deceit, revenge, imitation, temperament, etc. The author has evidently great personal familiarity with the horse and has read much literature upon the subject.

Insects: Their Structure and Life, by GEORGE H. CARPENTER. J. M. Dent and Co., London, 1899. pp. 404.

This is an admirable book copiously illustrated with nearly two hundred cuts and with a voluminous and well selected literature at the end. It first describes the structure and form of insects, then their life history, classification, orders, their surroundings, and their pedigree. The author is an expert entomologist of King's College, London.

Animal Behavior, by CHARLES O. WHITMAN. Woods Holl Biological Lectures, 1898. Ginn and Co., Boston, Mass., 1899. pp. 285–338.

The author is Head Professor of Biology at the University of Chicago, Editor of the Journal of Morphology, and Director of the Biological Laboratory at Woods Holl. In this pamphlet he has described the behavior of clepsine and the necturas under various stimuli designed to test their psychic activities. These are made with the author's usual care and pains and are valuable records, but more interesting to psychologists are the last twenty-five pages in which he characterizes the theories of instinct, and defends the view that pure instinct cannot be accounted for on Lamarckian principles, that the primary roots of instinct reach back to the nature of protoplasm and run parallel with organogeny, that instinct always precedes intelligence and is never lapsed mind. Psychologists never had so warm a welcome for biologists who enter this field as now.

Physiologie des Gefühls, von Z. OPPENHEIMER. C. Winter, Heidelberg, 1899. pp. 196.

This is a very important work by a very competent author who discusses first of all the free nerve endings, their path to the spinal cord, their influence under strong stimulation and the effect of weak stimulation which the author relates to feeling, the causes of satiety, appetite, hunger and thirst, the feeling center in the brain, and the likeness and contrast between pleasure and pain.

Das sexuelle Elend (der oberen Stände), von HEINZ STARKENBURG. W. Friedrich, Leipzig. pp. 139.

This is a sociological study largely based on statistics, showing in various lands a great increase of sexual crimes, with theories for cause and cure.

Geschlecht und Kunst, von GUSTAV NAUMANN. H. Haessel, Leipzig, 1899. pp. 193.

The relations between instinct and intellect, the development of the sexes, art and ethics, the genesis of the artistic, are treated in an interesting but popular way in order to lead up to the concluding chapters, one on Aphrodite and Athene, and the other on Dionysos and Apollo. The whole is intended as a prolegomena to a not yet written physiological æsthetics.

Schönheit und Liebe, von JOSEF SCHENK. F. W. Ellmenreich, Meran, 1899. pp. 81.

The author here grounds a new branch of æsthetics. After an introductory section, we are told in poetry the nature of beauty and of love, and after a longer prose chapter more poetry, and then again prose follows. The author moves, however, in a realm of very abstract definition and can hardly be said to have added to our knowledge of his theme.

Der Geschlechtstrieb. Die Idealisierung. Die Liebe. Von ANNA SERGEIEFF. W. Friedrich, Leipzig. pp. 98.

This well meaning lady would idealize love, in fact ideality and love are inseparable from each other, and this leads her to the conclusion that love is not chiefly an affair of youth but of mature years and even of old age.

"Genesis" Das Gesetz der Zeugung, von G. HERMAN. 1 Bd. Sexualismus und Generation. A. Strauch, Leipzig, 1899. pp. 143.

This is the first volume of a comprehensive and very speculative work upon the subject, though based on a wide reading in the biological field. The chief subjects treated are—polarity and its relation to sex; the nature of living substance; embryology; heredity; sexual selection; painless birth; and education of parenthood.

Die Wirkungen des Geistes und der Geister im Nachapostolischen Zeitalter bis auf Irenäus, von HEINRICH WEINEL. J. C. B. Mohr. Freiburg, Leipzig, und Tübingen, 1899. pp. 234.

In this typically German monograph, we have a very interesting and thorough presentation of the prevalent belief of early Christendom in spirits, good and bad, the effect of Christianity in weakening the power of evil spirits, an account of their modes of activity in causing glossolalia, ecstatic, and revelationary utterances, working miracles, causing cramps, sometimes in prompting or dissuading from great actions, the hearing, seeing and knowing of spirits and their effect in the field of smell, taste and touch, and the effect of baptism, anointment, prayer, asceticism, and suggestion upon pneumatic states.

Human Nature: Its Principles and the Principles of Physiognomy, by PHYSICIST. Parts 1 and 2. J. and A. Churchill, London, 1899. pp. 128, 175.

This anonymous work attempts to deduce human nature from the general physical, chemical and biological principles in order in the second volume to give a basis for the new classification of characters and to explain certain cardinal principles of physiognomy.

Brain, in Relation to Mind, by J. SANDERSON CHRISTISON. Chicago, 1899. pp. 143.

After hastily glancing over the new views concerning brain cells and their relations, and the theory of sensory and motor centers, the author proceeds to summarize current views concerning location of mind and to point out the relations of form and size to it, and to characterize normal mind. The writer's mind is suggestive and schematic, and his work although fragmentary is rather interesting reading.

La Doctrine de Spinoza. Par ÉMILE FERRIÈRE. Paris, F. Alcan. pp. 357.

This exposition and commentary of Spinozism in the light of modern science by this voluminous and able author is an attempt to state and disprove the entire geometric apparatus. Happily at the end of every

chapter is a synoptic résumé of its content. A comparison of stoicism with Spinozism which runs through the work is as interesting as it is unique.

The Revelation of Jesus. By GEORGE H. GILBERT. New York, The Macmillan Co., 1899. pp. 375.

This is a study of the primary sources of Christianity by a professor in the Chicago Theological Seminary, already widely and favorably known for his "Students' Life of Jesus and of St. Paul." Only Wendt had attempted so comprehensive a scheme before, and to make the revelation of Jesus historical was a distinct step in advance. An alternative title of the book might be The Conception and Development of the Kingdom of Heaven.

The Ritschlian Theology. By ALFRED E. GARVIE. Edinburgh, T. and T. Clark, 1899. pp. 400. Imported by Charles Scribner's Sons, New York.

At last we have a comprehensive work, critical and constructive, both an exposition and an estimate, as the title has it, of Ritschl and his school. Although attention is focused upon the few distinctive features which characterize it. Kaftan, Harnack and Herrmann are the only members of his school who are treated. They are allowed to speak for themselves, but the author is, on the whole, more critical than expositional. The doctrines chiefly treated are those of the church, sin, salvation, the kingdom of God, the nature of revelation, and the personal work of Jesus.

Das Schöpfungsproblem, von WILHELM WAAGEN. Münster, 1899. pp. 36.

We have here a very interesting attempt to epitomize current scientific views of cosmogony and to bring them into harmony with the record of the Old Testament. Much has to be forced and is artificial, but one cannot close this pamphlet without realizing that science and the Bible are after all not so very much opposed to each other.

NOTES AND NEWS.

NOTES.

The Thirteenth International Medical Congress.

The thirteenth International Congress of Medicine will be held at Paris, 2–9 August, 1900. The president is M. Lannelongue, rue François 3; the general secretary, M. Chauffard, rue Saint-Guillaume 21; and the general treasurer, M. Duflocq, rue Miromesnil 64, Paris. The Congress will be divided into five sections: biological sciences, medical sciences, surgical sciences, obstetrics and gynæcology, public medicine,—the first two offering features of special interest to psychologists. Information concerning conditions of membership, presentation of papers, etc., may be obtained from Dr. H. B. Jacobs, secretary of the American National Committee, 3 West Franklin Street, Baltimore, Md.

A New Method in the Study of Optical Illusions.

We have received, too late for review, an important paper by Dr. H. Stadelmann of Wuerzburg, which presents a new method for the classification of optical illusions. It will be remembered that Witasek (*Zeits. f. Psych.*, xix, 81) divides all current theories of optical illusion into two great groups,—perception theories and judgment theories. According to the former, we 'see' wrongly; according to the latter we see rightly, but judge incorrectly as to what we have perceived. Dr. Stadelmann puts his subjects in the somnambulistic state, and inhibits by suggestion the influence of the *Trugmotive* in a given illusion-figure: *e. g.*, the oblique lines in the Mueller-Lyer parallels. If the illusion is perceptive, he argues, this removal of the *Trugmotive* will leave the illusion intact when the subject is confronted with the figure in the waking state; if the illusion is, on the other hand, a matter of associated ideas or of judgment, then the inhibitory suggestion will kill the illusion. He finds that the illusion persists, after as before; and so concludes (with Witasek) that the perception theories are preferable to such interpretations as that offered by Lipps. The paper appears in the *Festschrift der phys.-med. Gesellschaft*, Wuerzburg, 1899.

The Need of another Psychological Journal.

It would appear at first sight, that the American public is well enough supplied with psychological magazines. Besides the *American Journal of Psychology*, a quarterly, and the *Psychological Review*, a bi-monthly journal, we have *Science*, a weekly devoted to the interests of science at large, and containing a fair proportion of psychological matter, and various philosophical magazines, all opening their pages more or less readily to articles of psychological tenor. Nevertheless, I venture to think that there is room for a psychological journal of a type different from any and all of these: a journal which shall approximate, as does, *e. g.*, the *Open Court*, more to the newspaper form, and which shall serve, somewhat as the *Intermédiaire* of M. Binet was intended to do, as a means of communication between students of

psychology, amateurs interested in psychological problems, and makers of psychological instruments. The contents of such a journal would consist, quite largely, of Discussions, the replies and counter-replies to criticisms,—the Corrections and Explanations,—that are necessitated by hasty reviewing or by honest misunderstanding, and that now occupy too conspicuous a place in pages that were better filled by constructive articles. The 'preliminary notice' might also be banished from the more serious magazines to the columns of the new journal; there might be interchange of question and answer between those who are less and more favorably situated with regard to library facilities; new apparatus, wherever described, might be redescribed and figured; European appreciations of American work might be published more quickly and less formally than is now possible; the barriers separating school from school, and laboratory from laboratory, might be, at least to some extent, broken down, and a common psychological atmosphere breathed by all workers in the science. Many a scientific controversy would dissolve into nothingness, could it be thoroughly threshed out by free and informal discussion; and many a dispute is perpetuated by the present conditions of publication.

I believe, then, that there is a place for a monthly paper or journal, of the kind outlined, and that it would be well worth the while of some one or more of our younger psychologists, not as yet hampered by other editorial duties, to undertake it. Advertisements ought to go far towards making such a journal self-supporting from the outset.

E. B. T.

NEWS.

Miss L. J. Martin has been appointed acting assistant professor of psychology at Stanford University.

An International Congress of Ethnology will be held at Paris, August 26 to September 1. One of the seven sections will be devoted to ethnographical psychology.

The eighth annual meeting of the American Psychological Association was held at New Haven, Dec. 27–29. The plan of meeting in two sections (an experimental and a philosophical), tried for the first time at this meeting, worked satisfactorily, though many members would have been glad to have been present in both sections at the same time. The feeling was general that time should not be given to sectional meetings to the detriment of the general meetings of the Association; and there seemed little desire to take any action that might lead to an actual division of the Association.

Besides going through the extended programme of papers, the following business was transacted. The officers were elected: President, Prof. Joseph Jastrow; members of the Council for three years, Prof. W. L. Bryan and Prof. George T. Ladd. Prof. Livingston Farrand remains Secretary and Treasurer, having been elected for three years. A large number of new members were also voted in. By an informal vote the Association expressed its willingness to meet in Chicago in 1901, should it at that time seem advisable to do so. Professors Bryan and Lindley, of the University of Indiana, were voted fifty dollars from the funds of the Association for the furtherance of their investigations upon the interesting mathematical prodigy whose skill they had demonstrated before the Association. The customary acknowledgments, also, were voted to Yale University and the members of its philosophical department—the hosts of the Association on this occasion.

The address of the outgoing President, Professor Dewey, will be published in the *Psychological Review* for March.

We learn from *Science* that the chair of Psychology at Columbia University has been endowed by Mr. J. D. Rockefeller with the sum of $100,000.

The Psychological Laboratory of Columbia University has recently undergone extension; it now consists of a series of 19 rooms,—a number reached heretofore only by Professor Wundt's Institute at Leipzig.

In *Nature* of Jan. 4 appears a protest by Professor Baldwin against the report of the Committee of the Royal Society Catalogue of Scientific Literature, in which the recommendation is made that psychology be classed under physiology, that the schedule submitted by Mr. G. F. Stout be cut up, and that fractions of it be inserted where place can be found for them under physiological headings. We are glad to endorse to the full the protest thus made against a suggestion which is both unwise and unjust.

Erratum: In foot note 1, page 191, for "Published in 1852 in Cincinnati" read "Published in London 1844." It may also be added that though the book in question (Vestiges of the Natural History of Creation) went through many editions anonymously it is now known to have been the work of Robert Chambers, publisher and litterateur, of Edinburgh.

BOOKS RECEIVED.

CHRISTISON, J. SANDERSON. Brain in relation to mind. Published by the Author, Chicago, 1899. pp. 143. Price, $1.25.

——— ———. Crime and criminals. Published by the Author, Chicago, 1899. pp. 177. Price, $1.25.

LE DANTEC, FELIX. Lamarckiens et Darwiniens, discussion de quelques théories sur la formation des espèces. Félix Alcan, Paris, 1899. pp. 192. Price, Fcs. 2.50.

DESCARTES, RENÉ. Discourse on method. Veitch's Translation (*Religion of Science Library*). Open Court Pub. Co., Chicago, 1899. pp. 87. Price, 25 cts.

DURAND, J. P. Nouvelles recherches sur l'esthétique et la morale. Félix Alcan, Paris, 1900. pp. 275. Price, Fcs. 5.

FÉRÉ, CH. L'instinct sexuel, évolution et dissolution. Félix Alcan, Paris, 1899. pp. 346. Price, Fcs. 4.

FERRIÈRE, EMILE. La doctrine de Spinoza exposée et commentée à la lumière des faits scientifiques. Félix Alcan, Paris, 1899. pp. 357. Price, Fcs. 3.50.

FULLERTON, GEORGE STUART. On Spinozistic immortality. (Publications of the University of Pennsylvania, Series in Philosophy, No. 3.) Ginn & Co., Boston, 1899. pp. 154.

GARVIE, ALFRED E. The Ritschlian Theology, critical and constructive. An exposition and an estimate. Imported by Charles Scribner's Sons, N. Y., (T. & T. Clark, Edinburgh,) 1899. pp. 400. Price, $3.00—net.

Human Nature, Its principles and the principles of physiognomy. By Physicist. J. and A. Churchill, London, Part I, 1897. pp. 128. Paper, 2 shillings; Part II, 1899. pp. 175. Price, 2s. 6d.

Jahresbericht ueber die Leistungen und Fortschritte auf dem Gebiete der Neurologie u. Psychiatrie. Jahrgang 2, 1898. S. Karger, Berlin, 1899. pp. 1406. Price, 32 marks.

JANES, EMILY (Editor). The Englishwoman's year book and directory, 1900. Adam & Charles Black, London, 1900. pp. 340.

JOHNSTON, CHARLES. The memory of past births. The Metaphysical Publishing Co., N. Y., 1899. pp. 50. Price, 25 cents.

LOOMIS, ERNEST. Seven essays on the subject of force-massing methods. Showing how to use occult forces, etc., in all business and art. Ernest Loomis, Chicago, 1899. pp. 134 + 22. Price, $1.25.

NAVILLE, ERNEST. Les philosophies négatives. Félix Alcan, Paris, 1900. pp. 263. Price, Fcs. 5.

OPPENHEIM, H. Nervenleiden und Erzichung. S. Karger, Berlin, 1899. pp. 56. Price, 1.20 marks.

PETZOLDT, JOSEPH. Einführung in die Philosophie der reinen Erfahrung. Erster Band. Die Bestimmtheit der Seele. B. G. Teubner, Leipzig, 1900. pp. 356. Price, 8 marks.

RIBOT, TH. The evolution of general ideas. Trans. by Frances A. Welby. Open Court Pub. Co., Chicago, 1899. pp. 231. Price, $1.25.

ROWE, STUART H. The physical nature of the child and how to study it. The Macmillan Co., N. Y., 1899. pp. 207. Price, $1.00.

STARBUCK, EDWIN DILLER. The psychology of religion. An empirical study of the growth of religious consciousness. With a preface by William James. Contemporary science series. Walter Scott, Limited, London, 1899. pp. 423. Price, 6 shillings.

WINDELBAND, W. History of ancient philosophy. Authorized translation by Herbert Ernest Cushman. From the second German edition. Charles Scribner's Sons, N. Y., 1899. pp. 393. Price, $2.00.

WOOD, HENRY. The political economy of natural law. Lee & Shepard, Boston, 1899. pp. 305. Price, in paper, 50 cts.

WOOD, HENRY. Ideal suggestion through mental photography. Lee & Shepard, Boston, 1899. pp. 163. Price, in paper, 50 cts.

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There also appears, under the head *Philosophical Periodicals*, a list of the titles and an indication of the contents of the articles in the leading philosophical journals, English and foreign, with a further notice of those which appear to be of special importance. *Notes* on recent researches and current news conclude each number.

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ON THE PSYCHOLOGY AND PHYSIOLOGY OF READING. I.

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In the experimental study of which this is a partial report I have planned to make an analysis and description of the reading process. Until very recently no general attempt has been made to analyze and describe the psycho-physiological processes involved in reading. Isolated studies on the perception of letters, partial investigations of the movements of the eye in reading, etc., have furnished material, and especially, suggestions, valuable for the general study; but neither a synthesis of these partial studies nor any other attempt to tell just what readers do when they read, was to be found. Such work as has recently been done, as the admirable work of Goldscheider and Müller and Erdmann and Dodge, will be considered later.

Some general account of what we do in reading seems to be much needed in view of the fact that reading is one of the most frequently performed psycho-physiological operations, and is fatiguing, often disastrously so. What are the conditions of this fatigue? Do the interpreting processes become tired or the retina or the oculo-motor or accommodation muscles—or is fatigue due to a combination of these causes—or to tiring of the accompanying motorizing or auditizing mechanisms? The answer must finally come from an analytical study.

Moreover, it has been believed, though less strongly at present than a few years ago, that the reading in schools is the cause of the tremendous progress of myopia. What does the eye do in reading that tends to bring such direful consequences?

Again, readers of apparently equal intelligence differ remarkably in speed of reading, some reading four times as fast as others with apparently equal quality of interpretation. Here may be a tremendous loss, which may be remediable in the light of an understanding of the processes involved.

And then typography has been evolving some hundreds of years under stress of economy, not of the eye and brain so much as of printer's paper and printer's ink. Printers and publishers have been industriously developing the system of straight, thin, horizontal lines made up of groups of little black strokes packed in neatly and compactly. But do we know that this development has not been straight away from the arrangement most suitable for quick and easy reading? It is true that fatigued readers have had some selective part in this evolution. But they have been offered a most limited range of variations from which to choose, and the fundamental notion of line arrangement and word arrangement remain as immutable as the fixed species of Aristotle. Can books and periodicals be printed so as to lessen fatigue, to decrease the tendency to myopia, to increase the speed of reading, to permit more fluent interpretation? Can pupils be profitably taught to read faster or more slowly, to visualize or auditize or motorize, in general can they improve their reading method? These are some of the pedagogical problems to be finally solved by such an analysis of the reading process.

To explain fully the "how" of reading would be to write a treatise on the senses and intellect, and, in fact, to say the last word on many of the fundamental problems in psychology. The present study is but a beginning of what should be done in this field. It is hoped that it may at least make the general subject easier of approach.

In view of the fact that the reading process *per se* has been so little studied, and that the many studies bearing on the general problem are of so detached a character, I have thought that historical reference would be most helpfully made in connection with, or introductory to, my own treatment of the different problems, so I shall at once proceed to the discussion of eye movements in reading.[1]

To the many friends who have assisted me during the progress of his research I wish to offer my grateful acknowledgments. I am peculiarly indebted to Professors Hodge and Sanford for cheerfully incurring the inconvenience involved in serving as subjects for the experiments upon the eye, and to Dr. Burnham for criticism and advice. I wish also to express my gratitude to M. Javal for kindly forwarding to me personal papers bearing on his researches.

Eye Movements.

What does the eye do in reading? Javal[1] found that he had straight continuous after-images of gray lines after reading, and concluded that the fixation point did not leave the line as the eye moved forward. He evidently believed that the fixation point moved over each line in reading.

Finding that the upper half of the letters was most important for reading, as can be seen at once by dividing a line in halves horizontally and comparing the legibility of the upper and lower halves, he concluded that the fixation point moves along between the middle and top of the small letters.

Ahrens[2] by fastening a bristle 10 cm. long to an ivory cup attached to the eye found that it made a straight sweep forward in reading, but the method could not show stoppages en route, and he does not seem to have suspected their existence. Lamare,[3] working with Javal, finding that the movement of the eye in reading was not continuous, but by little jerks (*par saccades*), devised the following method for counting these: A blunt point placed upon the upper eyelid of the reader put in action a microphone, whose sound, transmitted by a rubber tube, made known each movement to the ear of the experimenter the short reading jerks causing a brief sound, while the extensive movements made in passing from the end of the line to the commencement of the next, caused a more prolonged sound. With a little practice he found himself able to count the movements. He was surprised to find that the number of jerks remained the same whatever the distance from the reader to the book. Javal says: "*Cette distance n'avait donc aucune influence sur la grandeur absolue des sections*," and, again, "*il devenait donc évident que le lecteur devise la ligne imprimée en sections précisement aussi grandes qu'il convient pour que l'œil dirigé vers le milieu de la section puisse encore distinguer en vision indirecte les lettres qui en forment le commencement et la fin.*" In this he seems to have generalized from insufficient data, as will appear later, but the observations are interesting.

Javal attaches much importance to the changes in accommodation necessitated, he thinks, as the distance from the eye to the point fixated changes during the movement along the line, and he thinks that these changes of accommodation are produced synchronously with the jerks.

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[1] Various articles, especially *Rev. Scientifique* 1879 and 1881.

[2] *Die Bewegung der Augen beim Schreiben*, Rostock, 1891.

[3] Des Mouvements des yeux pendant la lecture, *Comptes rendus de la soc. française d'ophthalmologie*, 1893, and elsewhere.

Landolt[1] found that the movement of the eye in reading was by jerks, and studied them by directly observing the reader's eye. He had his subjects read slowly, and was thus able to count the jerks (though he may well have thus introduced conditions quite foreign to normal reading). He found that an average of one and fifty-five hundredths words were read per fixation at a distance of 30 cm. Reading of a foreign language required more fixations, as did the reading of disconnected words, of numbers, and of lists of proper names. Landolt finds that the angular excursions of the eye are less as the distance increases, though the absolute amount read per fixation is somewhat increased. He claims that the movements through a small angle are very fatiguing, and that this may account in part for tendency of children to bring the book too near the eye, at the expense of the muscles of accommodation and convergence. Landolt, himself, recognizes the inaccuracy of his means of observation, and guards himself against more than general conclusions.

Erdmann and Dodge[2] also used the method of direct observation, watching the movements of the reader's eye as they were reflected upon a mirror. Their results will be referred to from time to time in reporting my own experimental work. As stated in a previous article,[3] I found myself able to determine by direct observation of the reader's eye that the movement was by jerks, and that the eye certainly moved along each line in ordinary reading, though it often seemed to the reader that it did not. But I considered and still consider the method inadequate to give any accurate account of even the number of movements of the eye (at least with some of my subjects), when they read at usual speed. It certainly could give no account of the extent of movement at each jerk, or of the speed, and in general it was entirely insufficient for the purpose. This was recognized in the work of Javal and Lamare, and I have already referred to its insufficiency in the work of Landolt.

I therefore arranged apparatus to get record of the eye's

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[1] *Nouvelles recherches sur la physiologie des mouvements des yeux.*

[2] *Psychologische Untersuchungen über das Lesen, auf Experimenteller Grundlage*, von Benno Erdmann und Raymond Dodge. Halle, Max Niemeyer, 1898. I have elsewhere (*Am. Journal Psych.*, Jan., 1899,) briefly and very inadequately reviewed this most important work. I regret that in the preparation of this article I have not at hand the notes from which I had hoped to make a fuller presentation of some of their results and methods. A fair comparison of our results would involve a critical and somewhat lengthy review of our respective methods of procedure in experimenting. Perhaps it is best, for the present at least, simply to refer the reader to the work itself, which, I hope, may soon be made accessible to those who do not read German.

[3] *American Journal of Psychology*, July, 1898.

movement by a direct attachment to the cornea of the reader's eye. The apparatus at first used has been described in my previous article already referred to.[1] As used later it consisted essentially of (1) a frame for fixation of the head fastened between iron standards, which were clamped to a heavy table; (2) of a light recording arrangement resting on the top of one of the standards, and connecting with a cup capping the cornea by means of a celloidin covered glass filament, or at other times by an aluminum wire, and writing its record on the smoked drum of a kymograph, by means of a light aluminum pointer; (3) of an arrangement for writing a time record on the drum receiving the eye tracings, consisting of a Deprez signal in circuit with a Baltzar interrupting clock set to mark $\frac{6}{23}$ sec.; (4) of a holder for the reading matter arranged to slide on a track allowing of easy adjustment of distance from the reader's eye; (5) of apparatus arranged to write a "spark" time-record on every part of the tracings of eye movements. The spark apparatus as used in most of the experiments was as follows: The secondary current from an induction coil was passed from one pole along the aluminum pointer, and sparked from its point through the smoked paper to the drum, which was connected through the kymograph to the other pole of the secondary circuit. The primary current of the induction coil was furnished by a Grenet cell, and was interrupted regularly by the vibrations of a tuning fork marking 147.4 vibrations per second. In order to reduce to a minimum the electrical resistance in this circuit, and thus get a stronger secondary circuit, this fork was driven by another, a fork of about 50 vibrations, with two Grenet cells in circuit, the 50 fork interrupting itself electro-magnetically. Thus at intervals of about $\frac{1}{150}$ sec. dots of soot were displaced by the spark, as the pointer moved forward, and a record of the eye's speed and movement was written at every point. By using a fast gearing of the kymograph the lengths of the eye's pauses were also recorded in some of the tests. The Deprez signal record at the side also gave the same.

The fixation of the head with reference to the recording apparatus and reading matter was obtained as before by having the subject bite into a mass of partially cooled sealing wax attached to a mouth-piece fastened in the head frame, the imprint of the teeth being preserved when the wax hardened.

The cups used were plaster of Paris of a curvature a very little less than that of the cornea, as light as they could be made and still be handled with safety. A hole was drilled

[1] See also the article by Prof. E. B. Delabarre in the same number of the *Journal*.

through the center of a diameter of 1.7 to 1.9 mm. The cup was placed on the left eye in all experiments.

The eye was rendered anæsthetic by the use of cocaine or holocaine. The latter was found most satisfactory and was used in most of the later experiments. The cocaine usually interfered with the accommodation, the holocaine probably never did so. The eye felt fairly comfortable during the experiment, and the reading proceeded normally.[1] The reader was directed to read by his normal method for the thought. Most of the passages read were taken from the back numbers of the *American Journal of Psychology*, having a line length of 98 mm., the type was 10-point or 8-point.

The tracings show that the eye moves over the matter line by line in all cases or in very nearly all. The movement along the line is in no single case continuous, but by quick jerks of varying length. In reading 89 of the longer lines, varying in length from 60.5 to 121 mm., there were but 13 retraceals,—about one in seven lines. My arrangement of apparatus could not record wanderings of the fixation above and below the line that was being read. There are, however, certain appearances of the tracings which lead me to think that this could have occurred but seldom; but a record in the vertical plane must be obtained before this can be finally determined. I incline to accept the conclusions of Javal on this point, except that I should expect the fixation point to have a somewhat larger range of variation, vertically, than from the middle to the top of the small letters.

The return sweep of the eye is almost invariably unbroken until near the end, where an occasional halt is made apparently to enable the eye to get its bearings in a new line. The tracings from 119 of the longer lines show 21 such stops. These are more numerous in the long line passages than in the shorter ones. This is as we should expect, if the return movement is guided by the peripheral stimulus from the new line's beginning received during the eye's last fixation in the preceding line. Such guidance would be less and less accurate as the length of line increased and might necessitate the haltings that

[1] This last was true so far as either the reader or experimenter could observe. The complexity of the apparatus, and the novelty of having an attachment to the eye, suggest much of distraction. But the subjects were accustomed to doing normal reading amid such surroundings from day to day, and the reader, for the most part, had little direct consciousness of there being any attachment to his eye—the attached eye feeling quite as free to move as the other one. There was some discomfort at times, especially during the removal of the cup, and after the experiment; but during the tests, so far as we can trust the reader's introspection, the reading proceeded as it ordinarily does. In my own case, at least, it seemed to be even a little faster.

the tracings show and the distraction noticed introspectively when we lose the line. However, several of the passages were read with no halt in the return sweep.

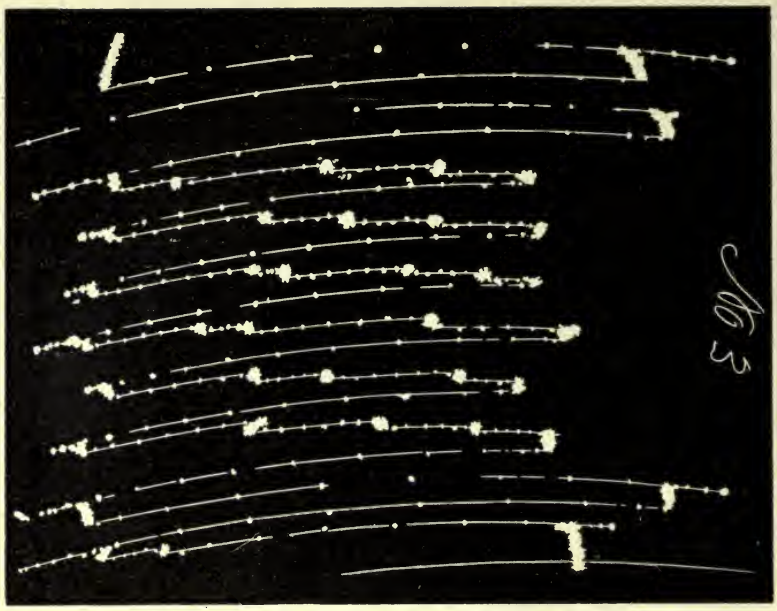
In reading the *American Journal* passages the smallest number of movements in any line was two, the largest seven. The variation, however, is usually not great within a given passage. In reading 30 lines (divided into three readings), subject Hu. averaged 4.8 forward fixations per line, with a mean variation of 0.5. In reading 51 lines (6 passages) under almost exactly comparable conditions, subject Ho. averaged 4.5 forward fixations, with M. V. of 0.6. These readings were at distances ordinarily used in reading, varying from 33 cm. to 42 cm., all but one of the passages being at distances of between 33 to 35.5 cm. The number of fixations per line is not found to vary with distance within these limits, nor indeed is the number decreased very appreciably even when the distance is doubled. The reading of 20 lines (2 passages) of the above by subject Hu. at 35.5 cm. distance, gave an average of 4.7 forward fixations, with M. V. of 0.5. Doubling this distance under otherwise comparable conditions gave an average of 4.5 forward fixations, with M. V. of 0.3. The reading of 47 lines at 35.5 cm. are comparable with a reading of 32 lines at double this distance, 71 cm. The former shows an average of 4.5 forward fixations per line, with M. V. of 0.54. The latter gave an average of 4.48 fixations, with M. V. of 0.45. It should be mentioned that these M. V.'s are averages of M. V.'s within the given passages, and that the variations in the number of fixations from passage to passage was much greater in the double distance passages. Decreasing the size of type seems to have but little effect upon the number of fixations. Thirty lines (three passages) of the smaller size of type, 8-point, from the *American Journal* read at 33 to 35.5 cm. distance, gave an average of 4.9 fixations per line, with M. V. of 0.5. Sixty-seven lines (seven passages) of the larger type of the *Journal*, read under similar conditions, gave an average of 4.7 fixations, with M. V. of 0.54. I have made most use of the results obtained from readings of *American Journal* passages because these are of a line length and type size most frequently met with, perhaps, by the subjects investigated, and I have wished to investigate the process of reading under its most normal conditions. Subjects have been tested, however, with the shorter line lengths.

Nineteen lines of a *Cosmopolitan* article with a line length of 60.5 mm. and the ordinary type size gave an average of 3.6 fixations per line, with M. V. of 0.5. Twenty lines (two passages) from a newspaper column, line length 52 cm., and the ordinary type size, gave an average of 3.8 fixations per line, with M. V. of 0.6, at distance of 35.5 cm. for one subject. With

the other subject 14 lines of the same passage gave an average of 3.4 fixations, with M. V. of 0.5, at 35.5 cm.; and an average of 3.6 fixations, with M. V. of 0.6, at distance of 52.7 cm. Shorter line lengths than this are not ordinarily found in reading, and investigation of reading under these special conditions belongs rather to the consideration of what should be than of what is. The results of some investigations in this field are reserved for a later report.

The tracings show that the eye seldom moves along the whole extent of the line, and that usually the first fixation is nearer the beginning of the line than the last is to its end. In the reading by subject Ho. one passage from the *American Journal* (10-point type) the side to side movement averaged 82.3 per cent. of the line length. In a similar passage the same subject averaged 78 per cent. of the line length. In a similar passage, subject Hu. averaged 82.2 per cent. of the line length when reading normally, and in a similar passage, read at maximum speed, 85.8 per cent. The M. V. is usually quite small in all tracings of this line length, the subject tending to maintain a fairly constant extent of movement throughout a given passage. The indentation, though usually greater at the right, is not always so. In some readings the first fixation must have fallen in the first half of the first word in most of the lines, while in other passages it must have fallen in the second or even in the third word. Individual variations in this respect are not demonstrable as between the readings of the two subjects. For a given passage the subject seems to fall into a way of indenting a certain amount right or left, and maintains this tendency throughout the passage.

The extent of the forward movements in reading is subject of great variations in all cases, and the conclusion of Javal that the eye moved over the extent of matter that could be read at one fixation (usually about the space of 10 letters in his opinion) is negatived at every point. To illustrate the great variability of the forward movements I shall give here the chords of the arcs traversed in some consecutive forward movements in reading a representative passage. The chords are very nearly proportional with the arcs within the limits of these movements. Chords (in mms.), 11.0, 26.0, 3.5, 11.5, 16.0, 13.0, 15.5, 23.5, 17.0, 10.0, 40, 12.0, 22.5, 12.0, 13.0, 13.5, 19.0, 4.0. Another passage, showing perhaps less variation than most of the others, gives 14, 14, 16, 14, 16, 19, 19, 5, 18, 18, 12, 11, 14, 9, 21, 13, 20, 18, 22, 7, 12, 15, 26, 17, etc. The extent of forward and return movements will be given in degrees and minutes in connection with the results of the measurement of speed.



Specimen Curve of 'Spark' Record.

This reproduction, cut by a careful engraver upon a block on which the original tracing had been protographed, shows with great accuracy the sort of record from which the times of the eye movements have been determined. The chief difference between the original and the reproduction is in the breadth of the horizontal lines which are finer in the original.

The curve shows the movements of the eye in reading six lines, preceded and followed by two free movements of the eye each way, in which it was swept from one end of the line to the other, the beginning and end alone being fixated. The broad vertical lines and the round blurs in the reading indicate pauses in the eye's movements, the successive sparks knocking the soot away from a considerable space. The small dots standing alone or like beads upon the horizontal lines, show the passage of single sparks, separated from each other by 0.0068 sec. The breaks in the horizontal lines indicate that the writing point was not at all times in contact with the surface of the paper though near enough for the spark to leap across, as shown by the solitary dots.

The tracing shows clearly the fixation pauses in the course of the line, the general tendency to make the "indentation" greater at the right than at the left, and the unbroken sweep of the return from right to left.

Speed of Eye Movements.

The speed of eye movements has been investigated by Volkmann, by Lamansky,[1] and more recently by Dodge.[2] No direct determination of the speed in reading was made by these authors, but it was assumed by Dodge that the determinations of speed for eye movement in general can be carried over to the reading process, and estimates based on this assumption are given.

Volkmann's method was bad, as Dodge has shown, and on careful examination of the method proposed by him for getting valid results from Volkmann's data I am of the opinion that it cannot be done, and that the results have little value as determinations of speed. Lamansky measured the speed by flashing a pencil of light into the eye at regular intervals, as the eye passed through a given arc, the light passing through the perforations in a uniformly moving disc, and being directed to the eye by a prism, the subject counting the after-images of the flashes appearing during the movement. He found a quicker movement in the horizontal meridian than in the vertical, and the speed increased with the extent of the excursion.

Dodge used a modification of the same method, and found a very much slower speed than Lamansky, which he is unable to explain, except on the ground of individual differences, assuming that Lamansky's work was accurately done. The time occupied in movements through various arcs, as given by these authors, is as follows:

Lamansky.	Dodge.
$6°=10\sigma$	$5°=15\sigma$
$16°=16\sigma$	$10°=16\text{–}20\sigma$
$32°=22\sigma$	$15°=30\sigma$
	$30°=50\sigma$

With the spark apparatus already described I have measured directly the speed of the eye in reading representative passages from the *American Journal*, 10-point type, line length 98 mm., subtending an angle of 15° 14′ at the distance used, viz.: 35.5 cm. The results below give the average arcs described in the movements and the averaged times occupied in traversing these arcs for two passages read by subject Ho., and four read by Hu.[3]

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[1] *Pflüger's Archiv*, 1869, p. 418 ff.

[2] *Op. cit.*

[3] I have selected these passages as least subject to error from the conditions of recording. The times given are subject to a certain range of error, which, however, I believe to be comparatively small. No matter how light the apparatus, there must remain a slight delay in starting, due to inertia, and an "overshoot" of the pointer in stopping. (I had first thought that the "overshoot" shown in the tracings might represent, in part, a movement of the eye beyond its intended fixation,

TABLE I.

Subject Ho.

	Forward Sweep. av. arc.	Forward Sweep. av. time.	Return Sweep. av. arc.	Return Sweep. av. time.
First passage,	3° 46′	41.8σ	12° 4′	51.6σ
Second passage,	3° 55′	40.7σ	11° 40′	54.7σ

Subject Hu.

First passage,	3° 21′	44.1σ	12° 4′	57.0σ
Second passage,	2° 52′	46.0σ	12° 8′	68.3σ
Third passage,	4° 14′	42.7σ	13° 4′	58.1σ
Fourth passage,	3° 27′	48.0σ	—— ——	——

The forward movements of the eye in reading are found to occupy a tolerably constant time, almost irrespective of the arc traversed. For example, in the first passage read by Ho. (table above) the M. V. of the extent of movement was 34.2% of the average, while the M. V. of the time occupied in these movements was but 10.2%. The smallest and largest arcs described in this reading were as 4 is to 26, while the range of times was as 4 is to 7. Excluding three exceptionally short excursions in this passage the movement range was as 7.5 to 26, and the range of times was 6 to 7. Part of even this small M. V. must be accredited to error in estimation of partial spark intervals, the error to be expected here being much greater than in measuring the corresponding extents of movement, though being of such a nature as to be largely corrected in averaging. So that except for movements of but a few minutes of arc, which would seem to occupy less time, the forward movement of the eye in reading would seem to occupy an almost constant time, with an M. V. that can hardly exceed 5 or 6%, and may be much less.

The measurements of the return movements given in the above table are for the return as far as the first stop. Usually, as has been mentioned, the eye's return sweep was without a

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with quick return. But a careful study of the tracings and comparison of tracings made with tubular glass pointers convinces me that the "overshoot" is of the pointer. The eye may not hit its mark at each move, but it comes as near as it needs to get its data.) Perhaps it will be found that the times given above should be increased slightly from these causes.

I append the weight of recording apparatus: Total weight of all apparatus moved by eye—.597 gram. Weight of cup most used—.092 gram. Weight directly resting on eye (cup, and one-half of celloidin-covered glass tube used as a connecting rod) .139 gram.

The pointer that wrote the tracings was suspended so as to barely touch the glazed paper. Care was taken that in the experiments there should be as little as possible of friction or play of parts.

break. The M. V. here, both for times and extents of movement, is small. In all the passages of above table, except the third and fourth read by Hu., the subjects read at normal speed. In the last mentioned passages the subject read at maximum speed throughout. The extent of the movements is seen to be somewhat greater, and there were fewer per line. But the subject evidently was unable to decrease the time required for the movement,[1] and in general there is nothing to indicate that the rate of movement is under control of the will.

Reading Pauses.

The time occupied in the reading pauses is a very variable one. One of the passages read by Ho. gave an average pause of 190.9σ, with M.V. of 48.6σ. Another representative reading by the same subject gave an average of 108.3σ, with M.V. of 32.6σ. In the latter passage, while the M.V. is certainly given correctly, as compared with the average, the average time of the pauses may be somewhat greater, the time being measured in this case by the spark record, and the current having a tendency to use the same path twice when the dots are so close together, as was the case here when the pointer was at rest. In the first passage referred to the time record is taken from the clock record written on the tracing, and is certainly correct as it stands. In another passage read by Hu., 22 reading pauses gave an average of about 183σ, and the same number of pauses from an equivalent passage read by Ho. gave almost exactly the same average (measurements by the clock record). The pauses in retraceals and those on the return sweep are usually shorter than the reading pauses proper, and are not included in these averages.

The passages read at maximum speed show a decrease in the length of the reading pause, and as the speed of movement is not increased it would seem that increase in speed of reading is brought about solely, or at least mainly, by decreasing the number and duration of the reading pauses. Additional tests must, however, be made before this can be conclusively stated.

In general no individual differences have been clearly made out as between the two subjects tested, except that the speed of eye movements appears to be a very little greater with Ho.

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[1] In one of these passages an average rate of 9.4 words per second was maintained, as recorded by the signal record from the laboratory clock, paralleling the spark record. In another passage read at maximal speed by Ho., a rate of 12 words per second was maintained—almost a "skimming" speed. These would certainly be maximal rates under any conditions, and indicate that the eye was free to do its fastest work so far as the apparatus was concerned. The apparatus seemed to do its work fully as well, and the tracings and spark records are as clear as when the reading was at normal speed.

The forward movements being so irregular in extent, it seemed that they might be best interpreted as reactions to word stimuli appearing in the right hand periphery at each pause of the eye in reading. It thus became important to know the reaction time of the eyeball to such stimuli.

The minimum time for such reaction was found by Dodge to be between 180σ and 230σ. His method was briefly as follows: From a point first fixated the subject moved to a second fixation point 12 mm. distant on the appearance there of a small letter *c*. Simultaneously with this a large letter O was exposed in such a way as to fall just within the blind spot while the eye remained at the first fixation point, but to become visible the instant the eye was moved. The length of the O's exposure necessary to make it visible was taken as measure of the eye's delay at the first fixation point or its reaction time, subject to a slight correction. The experiments were not extensive enough to determine even the minimum time more definitely than as above stated. The experiment is an extremely pretty one, but seemed to involve some possibility of error, and the times given seemed very long, as compared, for example, with the wink reflex. I have measured the reaction for one subject (subject S.) with the direct attachment apparatus already described. The subject fixated a large letter *A* at a distance of 36.3 cm., and on the exposure of a type-written word 4° 45′ (30 mm.) at the right moved his eye to that point or to a point somewhat beyond. The removal of the card covering the word at the right interrupted an electric circuit starting the Hipp chronoscope, and the reaction movement of the eye threw the end of the aluminum pointer into a trough of mercury, closing the circuit and stopping the chronoscope hands. A preliminary "ready" was given in the ordinary way. A series of reactions to auditory stimuli (produced to the right from the same fixation point) was also made at the same sitting. The stimulus was given by a sharp blow on a telegraph key.

At a later sitting a series of reactions to the same word stimulus given in the same way was made with the hand by pressing a telegraph key, and a fourth series was taken with the hand reacting to the same stimulus, given at the fixation point instead of in the periphery. The results are as follows: Fourteen visual reactions gave as an average 206.9σ, with M.V. of 20.7σ. Eleven reactions of the eye to auditory stimuli gave as an average 191σ, with M.V. of 31.4σ. Twenty-seven reactions with finger key to the peripherally given stimulus gave an average of 180σ, with M.V. of 13.9σ. Thirteen reactions with the finger key to the foveally given stimulus gave an average of 179.6σ, with M.V. of 9σ. From the time for eye reactions probably 10σ should be deducted for the movement occurring

before the pointer reached the mercury. The pointer was necessarily thus removed because of the fact that while the subject was maintaining what he supposed was an absolute fixation, the pointer constantly maintained a tremulous motion, evidenced by the clicking of the chronoscope armature as the circuit was made and broken, and the separation had to be great enough to prevent the possibility of such interference with the chronoscope registration.

The times for visual reaction of the eye showed a marked tendency to decrease even throughout the single sitting in which they were taken. The last six of these reactions (taken immediately after the auditory group which followed the first eight visual) gave an average of 181.7 as against the total average of 196.9. The auditory time showed less tendency to decrease. The visual eye reactions seem to be of the sensory type throughout, the auditory rather of the motor type, the subject remarking upon his tendency to wink and to make general muscular contractions with the auditory reactions. The times thus found for eye reactions are somewhat shorter than those given by Dodge, the minimum for visual stimulus being a little under 170σ, and the tendency being to fall still lower by practice. However, the results are in substantial agreement with his in showing that the reaction to visual stimuli by the eye muscles occupies much the same time as the reaction by means of the hand muscles or others that are under more conscious voluntary control.

In reading it may well be, however, that the reaction is somewhat, even considerably, quicker because of the heightened readiness for the stimulus produced by "associative expectancy," and, perhaps, also by the stimulus to reaction having been actually noted in the remote periphery even while the eye is fixated in the preceding line. The unconscious movements of the eye during fixation, observed in the reaction experiments, give ground for the opinion that "marginal contrast" is due to such movements, and, taken in connection with other phenomena, observed during the experiments with the attachment apparatus, indicate that the supposed fixation point is not at all certain to be the actual one, and that the subjective determination of what has been fixated must not be relied upon when much accuracy is desired. Persons affected with nystagmus will confidently state that they are maintaining fixation when their eyes can be plainly seen to wander through a pretty considerable arc, and the same phenomena seem to be present in a minimum degree in the normal eye. In fact, nystagmus may be regarded as but an accentuation of a normal and constant wavering in the equilibrium of the ocular motor muscles during fixation.

Word Perception and Extent of the Reading Field.

More or less valuable contributions to the study of this part of the reading process have been made by various investigators, beginning with G. Valentine (1844), and continued by Aubert, Donders, Helmholtz, Exner, and Baxt, of the earlier experimenters. These studies give us information as to the time needed for the recognition of letters and of words, and for their enunciation, and discuss to some extent the apperceptive contribution to sense perception in such recognition. The experiments of Baxt[1] give valuable information as to the time needed for retinal impressions (especially impressions from letter or word stimuli) to come to consciousness. It is to be regretted, however, that in most of these studies the actual conditions obtaining in normal reading were lost sight of, and the results cannot be carried over to the reading process.

Cattell[2] investigated extensively the perception of letters and words, and his results are to a considerable extent applicable to the conditions obtaining in reading. He exposed letters, words and sentences on the fall-chronometer, using .01 sec. as the "optimum time" of exposure. He found that from four to five isolated letters could be perceived at one exposure, or three to four short isolated words, and that twice as many words could be seen when given in connection. Short words were read more easily than single letters, and the difficulty of recognizing words did not increase proportionately with their length. For these and other reasons he argued that words are recognized as wholes, and even that sentences are thus recognized. In exposing sentences he arranged the words in double lines so as to get as much as possible within the range of clear vision, thus materially changing the conditions obtaining in normal reading. His investigations of the times needed for the perception and naming of letters, words, etc., need not detain us, as the very different conditions of association and expectation obtaining in normal reading make it very doubtful whether the results are applicable here except in a very general way.

From the side of abnormal psychology Grashey (*Archiv für Psychiatrie*, XVI, S. 654) and Wernicke (*Fortschritte der Medizin*, III u. IV, 1886) have discussed the phenomena of aphasia in their relation to the processes involved in perceiving words and letters, and are led to the conclusion that we read by letters rather than by words.

Goldscheider and Müller[3] took up this question, and made a

[1] *Pflüger's Archiv*, 1871.
[2] Various articles in *Wundt's Studien*, *Mind* and *Brain*, 1885-86.
[3] *Zeitschrift für klin. Med.*, XXIII.

careful study of the conditions affecting our recognition of words and of letters. They conclude that words are perceived both as syntheses of their perceived component letters and as individual units, the latter being, perhaps, the more usual method. They investigate the relative importance for auditory perception of the different parts of words, discussing the possibility of their being determining letters which stand for the word mainly in its memory picture, and are especially necessary for its perception. The beginning and end of a word, especially the first, were shown to be especially important, the word being recognized pretty readily when only these parts were exposed, for what they consider the optimum exposure time, about .01 second. Various other parts of words as the vowels, consonants, etc., were exposed, and sufficed for more or less prompt recognition in many cases. Goldscheider and Müller are inclined to the belief that the visual perception of certain letters of a word arouses the memory of the corresponding sounds of these letters, and that the sounds of the other letters, and thus of the whole word, are called up from association with these. Vowels were thought to be especially important for arousing the motor elements in word perception, and consonants for the auditory elements. Consonants were not thought to be generally more important than vowels for word perception. The relative importance of these elements might depend upon the reader's tendency to be motor or auditory-minded.

My own study, reported in an earlier article,[1] of the effect on speed and extent of recognition of removing the first or last halves of words from passages to be read, show clearly that the first half was much more important for word perception, as it occurs in actual reading. This by no means implies (though, at least, one reviewer of the article seems to have so understood the matter) that the fixation point is upon the first half of each word. Not over one-half or one-third of the words are fixated at all, and though the part usually fixated has not been accurately determined as yet, the results of the experiments of both Dodge and myself indicate that it may be in any part of the word, or even between the words. The *Blickpunkt* of consciousness has been too often and too closely identified with the eye's fixation point, and this identification cannot be maintained for the reading process.

The legibility of isolated letters and conditions affecting their recognition have been carefully investigated by Cattell[2] and Sanford,[3] and have been discussed more or less helpfully by Javal and Cohn. Helpful as these studies have been it seems to me there

[1] *Op. cit.*
[2] *Op. cit.*
[3] *American Journal of Psychology*, I.

is still greater need of the investigation of the legibility of letters in groups and in indirect vision as we normally make use of them. Here they must certainly have a somewhat different, perhaps a very different relative legibility. The need of such investigation has already been mentioned by Dr. Sanford. Then, again, if words rather than letters are the units, as seems to be already established, an investigation of the legibility of words as optical forms for recognition, and the possibility of improvement in their form and arrangement, may be as much in point as the investigation of letters.

Griffing and Franz[1] have made an admirable study of some of the conditions of fatigue in reading, such as size of type, spacing, leading, color and quality of paper, intensity and quality of illumination, etc., but did not attempt any analysis of the reading process. Quantz[2] has made an extensive study of speed in reading and the conditions affecting it, such as practice, eye-mindedness, intellectual ability, etc. His results will be considered in another connection later, but I may say here that it seems to me that no satisfactory determination, or at least no satisfactory explanation, of the conditions affecting either speed or fatigue can be made until the reading process itself is analyzed; and the treatment of this fundamental problem has not, as yet, been attempted in a thorough manner.

As a step in that direction I arranged a series of experiments intended to throw light on the process of perceiving words and sentences as they occur in reading, and at the same time to afford data for determining the extent of the reading field, as it may be called, *i. e.*, the extent of reading matter as ordinarily printed, which the reader can read at one fixation. For this purpose passages were selected from old numbers of the *American Journal of Psychology* of about average difficulty, and of more or less intrinsic interest to the readers. The type was of the 10-point size used in this article, and the arrangement of words and letters was similar. This material was cut out by lines and pasted end to end, so as to make sense continuously on 20 strips of cardboard, each 46 cm. long; the printed matter extending 36.5 cm. on each card. This printed matter was exposed to subjects, section by section, by the Cattell fall apparatus. The matter on the first two cards was divided into sections of 1.75 cm. each, on the third and fourth cards into sections of two cm. each, and so advancing by differences of 2.5 mm. to and including cards divided into 4 cm. sections. The subject sat in a fairly comfortable position with his head in a head-rest, and with his eye at a distance of 35.5 cm. from the reading matter. A white spot on the screen exactly opposite the mid-

[1] *Psych. Review*, 1896. [2] *Psych. Review*, 1898.

dle of the section to be exposed was fixated at a ready signal from the operator about two seconds before the screen was dropped. The falling screen exposed 73 mm. of sense matter of the usual arrangement of type, at about the ordinary reading distance, with the fixation point in the center, for a period of 15σ. As the investigations into the matter of an optimum exposure time by Cattell, Goldscheider and Müller, Quantz and others, gave a decided preference to the shorter times in the vicinity of 10σ it was decided to use them in preference to the longer time occupied in a reading pause, especially as it was not yet known how short the simple reaction time for the eye might be, and it was desirable to keep within this period. Most of the apparatus and screen was hidden from the subject behind a gray paper shield, which was pierced by a 2 x 9.25 cm. slit opposite the part to be exposed. The apparatus was so arranged that a light from a window should fall directly on the exposed matter. In making the tests before exposing a section the context leading up to it was read to the subject up to the last letter, and then the section containing the passage was exposed. The sections were thus given consecutively always with context. Practice tests were made with each subject before beginning the series, and a few exposures were given for practice before each day's experiments. After each exposure the subject dictated or wrote what he had seen, whether words or letters, marking as doubtful those not clearly seen, and reporting it if a word was merely guessed from context. The result of the first exposure was always regarded as the one to be regularly used, but from time to time second, third, and even tenth exposures were made whenever it seemed likely that this would be of value. The study began with the short section cards, but a return series was also arranged on other cards in an exactly similar manner, and given in reverse order, that is, beginning with large sections, and with equivalent but different reading matter. The smaller section cards of this return series were not exposed, however, and it has been found impossible also to apply the same quantitative treatment to them as to the large sections, owing to the constant overlapping of the extents seen from exposure to exposure. Besides the cards in which context was given a series of cards was exposed without giving context, the sections being 5 cm. apart, and given in reverse order, so that though the matter exposed was sense reading, no section made sense with any other. Four subjects have been tested, there being over 640 exposures to a subject when the complete double series was given, and not less than 360 have been given to any subject. I shall first give the results obtained in the investigation of the reading field. The results of the exposure of sense matter without context gives opportunity for comparison of the amount

read in the right and left periphery. The extent of matter read at first fixation continuously and correctly is given in mm. below as *C.* as measured on the exposed line direct. Another measurement (*R.*) is of the total extent of the reader's range of word or syllable perception, as shown by his recognition of a peripheral word or syllable, for example, at the right when not all was read correctly between this and the part perceived farthest on the left.

The extent of line read correctly to the right of the fixation point is given below under *R. C.*, and the corresponding range of perception to the right is given under *R. R.*, all in mm. The measurements under *L. C.* and *L. R.* are for the corresponding correct reading and perception ranges to the left. I give for comparison the measurements from the four cards exposed in four cm. sections with context given up to two cm. from fixation point.

TABLE II.

No Context.

SUBJECT.	C.	R.	R. C.	R. R.	L. C.	L. R.
B	21.33	24.23	9.43	11.50	11.90	12.73
S	10.25	11.25	4.68	4.98	5.57	6.27
T	23.80	27.60	13.90	17.20	9.90	10.40
H	32.40	34.88	19.75	20.90	12.65	13.98
Av. 4 Subj.	21.95	24.49	11.94	13.65	10.01	10.85

Context given to within 2 cm. of Fixation Point.

SUBJECT.	C.	R.	R. C.	R. R.	L. C.	L. R.
B	21.7	22.1	7.3	7.6	14.4	14.5
S	8.8	10.5	4.2	5.0	4.6	5.5
T	23.9	27.3	11.9	14.4	12.0	12.9
H	27.8	28.7	14.3	15.2	13.5	13.5
Av. 4 Subj.	20.55	22.15	9.4	10.55	11.15	11.60

Largest Amounts Read. No Context. One Exposure.

SUBJECT.	C.	R.	R. C.	R. R.	L. C.	L. R.
B	37	40	27	27	10	13
S	45	45	25	25	20	20
T	48	48	40	40	8	8
H	50	50	40	40	10	10

A card given in two centimeter sections was read correctly throughout by one subject with one exposure per section, and large parts of 2.5 cm. cards were similarly read. Usually, however, the special conditions of experimentation caused breaks here and there, even when the fixations were near together.

The fact that exposure of one section permitted reading into the following section which occurred from time to time prevents quantitative treatment of the result except for the cards given in large sections. The data, however, offer much of suggestion for a theory of word and phrase perception. The subjects were instructed to state just what they saw, whether of words or letters. Almost invariably words are given. Only rarely did subjects state that the next word began with certain letters, and it was still more rare that terminal letters at the left were given. From time to time subjects felt that they had seen letters, and that they had been recognized for the instant, but they could not be reproduced after exposure. Smaller forms than single letters, such as commas and other marks of punctuation, were recognized from time to time, subjects stating that they were clearly seen.

There was a general tendency to see phrases and word groups whose components were closely and characteristically associated. This seems to be at the foundation of the tendency noted in all subjects and constantly, to read most at one or other side of the fixation point, instead of in symmetrical arrangement about it, as the conditions of clearest vision would seem to demand. To illustrate, note the appended consecutive measurement for subjects T and B:

TABLE III.

Subject T.				*Subject B.*			
L. C.	R. C.	L. R.	R. R.	L. C.	R. C.	L. R.	R. R.
20	25	20	25	5	0	5	0
7	19	7	19	12	6	12	19
17	10	17	10	13	18	13	18
0	0	5	0	24	0	24	0
9	15	9	15	9	15	9	15
2	13	14	13	14	13	14	13
17	4	17	29	18	4	17	23
10	8	10	8	10	8	10	8

Thus while the average amounts read to the right and left of fixation point are not so very different (except when preceding context is given), as shown in Table II above, the difference of these amounts for particular exposures is often very considerable, and they are seldom equal. It would be interesting to collate these preferred groups (read to side of fixation point) and

compare them directly with the groups that would have been read if the conditions of clear vision alone had determined what should be read in the periphery. It is not to be supposed that preferred phrases and parts of sentences were those of which a memory image already existed in the mind of the reader. Many of the combinations read most easily undoubtedly had never been seen before. But the *form* in which they were cast was a familiar form, in which the sequences were such as to run parallel with the habits of expectancy formed in the reader's mind by long experience with such sequence series. In general the more the word groups tended to resemble isolated words, as when divided by punctuation marks, the less easily they were read. Prepositional phrases, substantives with a series of modifying adjectives, or with a closely linked prepositional phrase modifier, series of any kind which had a rhythmic swing were preferred. Certain words, usually rather unfamiliar ones, presented peculiar difficulties. It seemed almost impossible to bring about a recognition of them by repeated exposures when the subject failed to perceive them at the first. The word "titillation" was exposed to one subject ten times successively before recognition had proceeded so far as to call it "tilitation." All subjects had difficulty with this word; the letters would be clearly seen, but, apparently, could not be remembered long enough to enable the subject to construct the word. "*Raison d'être*" was a combination offering similar obstacles to construction from its component letters. It would be interesting, did space and time permit, to give concrete examples of misreadings, and of various other more or less significant phenomena noticed in the experiments.

Perhaps the chief value of these experiments has been the opportunity which they gave of somewhat extensive observation, at first hand, of the process of perceiving words and other reading-units. I hope, in a later article continuing this report, to sketch an outline of a partial theory of word and sentence perception, which has been suggested and supported by the phenomena observed.

DISTURBANCES OF APPERCEPTION IN INSANITY.[1]

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The relation of normal psychology to pathological mental states has up to the present time been almost disregarded, chiefly by reason, on the one hand, of the uncertainty of psychological theories and, on the other, of the insufficiency of classified data. Those having immediate charge of the insane, and most psychiatrists as well, have contented themselves with formulating working classifications of insanity, which, of course, have a value independent of scientific considerations. But within the last few years, chiefly through the work of Kraepelin and a few others, both parties have had an awakening in this direction. The psychologist is beginning to see that the facts of nervous pathology and defective mental states form one of the most illuminating side-lights of his science, while the physician dealing directly with insanity is learning that the way to arrive at a knowledge of his patient's condition and the best method of treatment can be ascertained only on the basis of a well-grounded psychology. Some effort has already been made to place the work of the asylum on a surer scientific basis, as may be seen from the last report of the Worcester Asylum. The present paper, based principally upon a study of delusional insanity, contains merely tentative positions, intended to show in a general way how the facts of normal psychology and insanity may be brought into closer relationship.

The word apperception has a history of various uses and applications. Before the rise of modern psychology and with philosophers such as Leibniz and Kant, the term has a peculiar metaphysical significance, which use we must exclude in the interest of science however well it satisfies our speculative inclinations. With Herbart, again, the word means the assimilation of a new element to a given mass, in which the new element loses entirely its distinctive identity. At the present time the word as used by psychologists may have especial reference to one of three facts: (1) the fact of attention or clear consciousness, (2) the peculiar organization of the mental contents which

[1] Paper read before the Association of Assistant Physicians of Hospitals for the Insane, Cleveland, O., September, 1899.

makes clear consciousness possible, and (3) the conative processes which make consciousness a changing and active instead of a fixed organization. Wundt found in the first of these the point of departure for his doctrine of apperception. His effort was to explain the fact that at any given moment consciousness exhibits a series of gradations from the point of greatest clearness to entire obscurity, or, to use his own metaphor, the fact that there is a *Blickfeld* or field of consciousness, certain portions of which stand at the *Blickpunkt* or point of clearest vision. But in view of the sensationalistic theory that the clearness of consciousness is determined directly by objective conditions, Wundt finds it necessary, in order to justify his theory, to show that the clearness of apperception has a more comprehensive meaning than the mere intensity of sensation. This is proved in general by two facts, (1) the ability of the *Blickpunkt* to move over the entire field of consciousness under the same set of external conditions, and (2) the inverse ratio existing between the number of ideas apperceived and the degree of clearness of any one of them. In this way Wundt justifies the claim of apperception to be a mental process possessing relative independence.

The fact that at any given moment one idea rather than another appears in clear consciousness points to some kind of organization of the mental contents and to some kind of interaction. The study of apperception in this direction has been most completely carried out by Dr. Stout. With him the term means the organization and activity of "systems" or unified groups of sensations ("Analytic Psychology," Bk. II., Ch. V–VIII). Under this view perception is not a process independent of apperception, functioning only in the acquisition of raw material, but is itself a process of the apperceptive activity. A sensation does not, so to speak, force itself into consciousness and lie loose and isolated until it finds its place, but its very reception is conditioned by the reaction upon it of consciousness as a whole. The activity of consciousness is then essentially synthetic. A group of sensations are fused together in such a way as to form a system which, when its formation is relatively complete, selects one of its elements to represent the whole. For example, when I see any object, as a book, there is present a whole complex of tactile and kinæsthetic sensations of which I am unconscious in the act of perception. Being a visualizer, if I close my eyes and feel raised lettering, I can get no idea whatever of what the letters mean. This shows that in the synthetic grouping of sensations in my consciousness visual elements emerge and, so to speak, assume the leadership of the groups. These primary groups again combine into more comprehensive systems, each in turn represented by

one of its own elements. The mental contents then seem to have a compacted hierarchical organization comparable to that of an army, in which each of the subordinate units, represented in its head, is subsumed into the one above it. This organization is not to be thought of as static, but rather as interactive. In fact, this view is the only one that can explain the third set of phenomena included under the term apperception — the 'forces' of mind. With Wundt activity issues in little more than a very indefinite *Thätigkeitsgefühl*, while, according to this conception, the conative processes form the very conditions which make the 'field of consciousness' possible.

Let us now substitute words of psychological usage for the somewhat abstract terminology hitherto employed. *Sensation*, *idea* and more or less complex *associations of ideas* stand for successive stages in the hierarchy of conscious systems. There is a dual activity in consciousness to which we shall refer again, namely, the functioning of all the subordinate systems in the formation of a judgment, and the activity of judgment or the organization of consciousness as a whole in the reception of new sensation elements. With this very general statement of the theory of apperception, we will now proceed to discuss some of its most apparent disturbances manifested among the insane. It is to be remembered that in dealing with apperception we are passing beyond the field where psychology has most successfully applied exact experimental tests, so that our theories lack in large measure that experimental certainty which science so much desires. Again, the difficulties in the way of an experimental investigation of mental disturbances are apparent without mention. Yet, practically, all studies of insanity on the psychical side must deal with disturbances of apperception. Says Kraepelin: "Was wir heute untersuchen können, sind vielmehr im wesentlichen nur die Auffassung von Sinnesreizen, das Gedächtniss, die Vorstellungsverbindungen, die Auslösung von Willensantrieben, und die Ausführung von Muskelbewegungen" (Psych. Arbeiten, Bd. I, p. 30). On the physiological side microscopy has yet to win its greatest victory in the study of living tissue. Still its triumphs in the past make us optimistic in regard to its future attainments. As yet our knowledge is limited to certain forms of degeneration manifested in cortical areas and association fibers. As to the inner changes of the cell and the functioning of the fibers we know almost nothing.

It is impossible to make any general statement as to how insanity begins. It may be seen from Kraepelin's studies in *künstliche Geistesstörungen* that so far as concerns therapeutically induced mental disturbances, no definite method of attack can be postulated. The same is apparent to any one familiar with the various forms of insanity. Even in dementia, by which

is meant a general nervous and mental weakening, an indefinite number of mental elements may be picked out as seats of disturbance, while others are in only a small degree impaired. Except in idiots and the very worst dements a certain residuum of normal activity seems to go on automatically. This would indicate that while the connections between systems of different strata may be disturbed or destroyed, there is still an associative connection between co-ordinate systems: moreover, that this associative connection is more pronounced the lower we go in the hierarchy of the conscious contents. The matter is somewhat more accessible in delusional insanity. Here we can trace with some degree of definiteness the manner in which the apperceptive function is disturbed.

We have seen that the highest activity of consciousness regarded as a unitary system is represented in the formation of the judgment. This central representative system is what is commonly spoken of as the "point of view." This system, whether we are conscious of it or not, is implicitly present in every judgment we form, and, so to speak, stands for the integrity of the mental life. Delusion may be defined as persistent error of judgment, by which we mean a disturbance of the relationship existing between the "point of view" and the ideas which it dominates. This disturbance may be of more or less permanence, and may issue in only a slight modification or a complete destruction of the controlling system of consciousness. Let us consider a quotation from Mercier. "A man might assure us repeatedly and day after day that he was Emperor of China, but if he conducted his business successfully, and if his conduct toward his servants, his family, his friends and all his surroundings, was normal and proper, we should never consider him insane. But if he were to go to town with a yellow silk umbrella we should begin to look upon him with suspicion; and if he were to send yellow buttons to distinguished strangers as a mark of distinction and favor we should no longer doubt that he suffered from insane delusion" (Sanity and Insanity, p. 103). The author uses this illustration to prove that the test of insanity lies only in conduct. The question might be raised as to whether a man's conversation cannot be considered a part of his conduct. I can see no reason why the man should not be considered sincere in his assurance, and his case one of mental aberration, between which and insanity proper only an arbitrary line can be drawn. As a matter of fact this is just the way in which many cases of delusional insanity develop. Systematized delusions may grow up very rapidly or very slowly, but they never spring into being simultaneously. If a man confidently assures us that he is Emperor of China, it is only a matter of time until he will perform acts such as carrying a yellow

umbrella and sending yellow buttons. Through some cause which lies within the province of the pathologist or the sociologist, a certain unified system of ideas is unduly emphasized in consciousness. At first its only effect is an abnormal absorption of attention as a more or less isolated unit, but gradually it modifies or supersedes the "point of view" until under it, as the controlling element, the subordinate units of consciousness are systematically arranged even down to the smallest details. I have in mind the case of a woman under my observation who believed that she was the mother of Jesus, and under this idea had a beautifully elaborated system of delusions pertaining to her past life, her future intentions, her presence at the asylum and her daily habits of life. In many cases of systematized delusions, however, the original point of view is not destroyed, but only modified. Thus the business man thinks he is making great commercial ventures, the scientist significant discoveries, and so on. All degrees of this modification may be found from the "queer," "eccentric," "crack-brained," "off," "cranky" person we meet every day, to the most deluded inmate of the asylum.

Another form of delusional insanity claiming our attention is that in which two ideas instead of one come to occupy the prominent place in consciousness. Each of these ideas has its own system of subordinate elements, and the patient passes from one to the other in response to certain accidents, mostly of a coenæsthetic nature. This is a possible method of explaining the changes in identity frequently manifested among insane patients. The disturbance of the apperceptive function may proceed until the power of forming judgments is entirely lost, in which case we find an indefinite number of delusions apparently without connection, based upon as many co-ordinate but more or less isolated systems. When the disturbance reaches the connection between the secondary systems and the ideas of which it is composed the patient is completely at the mercy of suggestion or merely associative connection. Even association is gradually destroyed, when results a state of more or less complete confusion which from the nature of the case is inaccessible for study.

Perhaps the most efficient agent in determining the manner in which delusions are formed is the *feeling-tone* of pleasantness and unpleasantness. These are regarded by most psychologists of the present time as elementary conscious states co-ordinate but not identical with sensations. Sensation is the conscious state attending the reaction of a definite sense organ to stimulation; feeling-tone, on the other hand, attends the reaction of the whole organism, and accompanies the general physiological process of anabolism or catabolism. The surest method of investi-

gating feeling-tones is by studying their bodily effect or accompaniments. These are for pleasantness, increased bodily volume, deepened breathing, heightened pulse and increased muscular power; for unpleasantness the reverse phenomena. We may deduce these general facts in regard to states of feeling. (1) They affect to a greater or less degree the whole of consciousness. (2) They keep the elements to which they are most strongly attached persistently before the attention. (3) They definitely affect all the organic processes in the way of acceleration or retardation. These facts seem to be of the greatest importance in the explanation of certain forms of insanity. Let us suppose that because of some organic derangement a strong feeling of unpleasantness arises in consciousness. It soon fixes itself upon some idea that lends itself readily to the adjustment, for example, the idea of persecution, already containing within itself a memory image of unpleasantness. Thus emphasized, the idea is kept persistently before the attention until it gradually assumes first place in consciousness, when the systematizing process begins. The activity of consciousness being slow and under the constant influence of the feeling-tone, elaboration of delusions is often carried to a wonderful degree of completeness. The history of mania is somewhat different from that of melancholia. Here the activity is so increased that time is not afforded for the formation of systematized delusion, but the attention passes rapidly from one idea to another, each one being for the time the controlling factor in consciousness.

Mention was made in the early part of this paper of the dual activity of consciousness; the associated action of the lower systems in the formation of judgments, and, on the other hand, the action of all the higher systems in the reception of new sense elements. It cannot be supposed, then, that a disturbance of the higher functions can be without serious consequences among the lower activities. These disturbances are variously spoken of as hallucinations, illusions, sensory fallacies, subjective perceptions, and so on. In order to understand the meaning of such disturbances it is well to find at the outset where they are most prevalent. That they exist to a limited extent in normal life no one can doubt. In insanity they exist in varying degree in mania, melancholia, dementia and delusional insanity. Concerning dementia Krafft-Ebing says: "As the mental images become less complex and vivid as memory fades and the patient gradually sinks into profound psychical weakness, hallucinations and illusions become ever rarer; the former, indeed, are almost unknown in advanced general paralysis, and the latter occur but seldom" (Die Sinnesdelirien, p. 48). To this let us add a quotation from Parish: "Delusional Insanity and Paranoia abound in hallucinations, so much so that some forms classed

under this head are designated 'hallucinated insanity' and 'paranoia hallucinatoria.' The sense-deceptions of delusional insanity are vivid in their externalization and resemble in their content the fixed ideas which they embody" (Hallucinations and Illusions, p. 23). The prevalence of fallacious perceptions in delusional insanity, and their gradual disappearance in progressive dementia, will immediately suggest some close connection with the systems whose derangement we have been considering. We will even venture so far as to say that they depend entirely upon the insufficient or abnormal activity of judgment. Kraepelin (Psychiatrie, p. 79) tells us that the influence of hallucinations upon the mind is not chiefly due to their strength as elements of perception, but to the close relationship in which they stand to the contents of the patient's habitual thought. Parish seems to take the opposite view that, instead of delusions causing fallacious perceptions, the latter cause the former. Speaking of the dangers attending auditory hallucinations he says (*op. cit.*, p. 30): "they lead him (the patient) to seek for explanations, and thus bring delusive ideas in their train." (*Cf.* Kandinsky, "Zur Lehre von den Hallucinationen," *Arch. für Psych.*, XI.) It seems to me that here consideration is given rather to the way in which the patient manifests his disorders than to any causal connection. We might better say that the patient is unconsciously searching for evidence to support his delusion, and when it presents itself in the form of fallacious perception he naturally explains it by the preconceived delusion. Again, this view is supported by the whole mass of psychological facts pertaining to perception. We must remember that ideas or combinations of sensations are not given to the mind as ready-made copies of external things, but that they are the product of a subjective fusion process. When any sensory element presents itself, all of consciousness displays an activity in its reception and the particular idea to which it has been before apperceived is projected to assimilate it, and the whole idea in combination with this element is externalized. Consequently, in the sense of externalized subjective elements, all of our perceptions are illusions. Evidently, then, this side of the matter can have no part in the definition; so that the only question left for consideration is the fallacious nature of the perception. This we must again say is a matter dependent upon judgment. The idea that the sun moves round the earth is considered an illusion at the present day, but it was not in ancient times. We simply occupy a different "point of view," and judgment corrects the perception. The same fact appears in connection with the common illusion of flying houses and trees when viewed from a moving train. A memory image of motion is attached to the impressions actually coming in. The

process of judgment serves to break up this complex and to relegate this image to the system to which it really belongs. When this corrective process is fully carried out the landscape no longer seems to move. Herein lies the difference between the trained scientific mind and the mind of common sense—the former is able to break up its ideas, and, on the basis of the data available, rearrange the elements in a consistent system. Science is constantly demonstrating to us the illusory character of our everyday perception. What is true of the ordinary man is in much greater degree true of the insane. If the ordinary man is constantly projecting the elements of his thought in perception, it is easy to see how the insane patient, with his abnormal "point of view," can see his delusion in every sensory process. If, again, the ordinary man is not able to draw any line between the subjective and objective factors in perception, we can hardly expect the insane person, with his weakened judgment, to recognize the difference between subjectivity and objectivity. If the foregoing is true, it is hardly necessary for us to indicate the fact that the definition, first presented by Esquirol and commonly accepted since, of illusion as the false interpretation of external objects, and of hallucinations as sensory images without external stimulation, is entirely inadequate. The distinction is based upon a physiological process that is by no means unambiguous, while here we are dealing with a distinctly psychological phenomenon. As Gurney says (Hallucinations, p. 155): "Every psychological phenomenon that takes the character of a sense-impression is a sense-impression. When the hallucinated person says, I hear so-and-so, or I see so-and-so, the words are literally true; for to him a hallucination is not merely like, or related to, a sense-impression, it is identical with it." The same view is supported, but in my opinion with insufficient treatment, by Kraepelin (Psychiatrie, p. 103): "Die Schwierigkeit, Einbildungsvorstellungen von fast sinnlicher Lebhaftigkeit scharf von der wirklichen Wahrnehmung zu trennen, ist die Ursache, warum bei Geisteskranken gerade die Vermischung von Sinneseindrücken mit selbst gelieferten, dem eigenen Vorstellungsverlaufe entstammenden Bestandtheilen eine so verhängnissvolle Quelle der Verfälschung ihrer Erfahrung wird."

In regard to motor disturbances manifested among the insane very little can be said at the present time. It is certain, however, that the old classification of them as diseases of the will is no longer tenable in view of the modern psychological facts. Motor phenomena are now regarded as necessary elements in all mental processes, and are not to be ascribed to a peculiar mental "faculty." It would seem, therefore, that the only genuinely motor disturbances are to be found in cases such as

epileptic convulsions, verbigeration, etc., while what are known as imperative ideas, obsessions, etc., probably have normal motor processes, with the real seat of disturbance in the apperceptive connection of ideas.

In conclusion, it must be admitted that the almost infinite variations in the forms of insanity make the present treatment of the subject seem very general and perhaps artificial. Moreover, those dealing in a practical way with the insane need most a specific, definitely determinable classification. It is to be hoped that the rapidly growing mass of psychological facts will soon enable us to speak with more precision. Our endeavor here has been to call attention to some of the work already done along this line and to suggest directions for further research.

SENSIBILITY TO PAIN.

By EDGAR JAMES SWIFT, State Normal School, Stevens Point, Wis.

The purpose of the following experiments was to test further the relation between sensibility to pain and age, to learn whether mental ability influences this sensibility, and, if possible, to determine the effect of mental fatigue on the threshold of pain.

The instrument used was Dr. Arthur MacDonald's temple algometer.[1] By gently pressing on the temples with the flannel-covered disk at the end of a rod running through a cylinder and connected with a spring in the cylinder, the threshold of pain was determined in grams for each temple. The subject was instructed to say "stop" the moment the pressure felt "the least bit disagreeable."

The two following tables, one for males and the other for females, give the threshold of pain in grams for the right and left temples, as indicated at the top of the third and fourth columns: The first column gives the nearest age of the subjects, and the second the number of subjects whose tests enter into the average.

It will be noticed that the left temple is more sensitive than the right. This agrees with the results already found by Dr. Arthur MacDonald[2] and Miss Carman.[3]

This sensibility to pain decreases with the increase in age until about 18 or 19 years, when it seems to remain nearly stationary, varying slightly with different individuals and hence with different groups. This variation, I think, is due to other causes than age, as I shall show later in this paper.

Females at all ages are, in general, more sensitive to pain than males.

I did not find the "increase of obtuseness to pain from ages 10 to 11" to which Dr. MacDonald calls attention.[2]

In order to find the effect of mental fatigue on sensibility to

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[1] Described in the *Psychological Review*, July, 1898.

The credit for starting this line of research belongs to Dr. Arthur MacDonald, of the Bureau of Education at Washington, and this paper is offered as a contribution to his valuable work.

[2] Further Measurements of Pain. A paper before the American Psychological Association in New York, December, 1898. Also Report of the Commissioner of Education, 1897-98, Vol. I, pp. 1111 and 1113.

[3] *American Journal of Psychology*, April, 1899, p. 393.

TABLE I.

Males.

Nearest Age.	Number of Persons.	Right Temple.	Left Temple.
7	2	875	875
8	2	650	625
9	5	1065	1050
10	8	825	800
11	8	978	940
12	6	1037	1012
13	11	1052	1036
14	5	1450	1450
15	10	1300	1305
16	15	1666	1651
17	12	1735	1729
18	7	2021	1992
19	15	1790	1708
20	15	2136	2188
21	9	1808	1788
22	6	1833	1858
23	5	2260	2140
24	5	1860	1860
25	4	1750	1675
26	1	1650	1650
27	1	1150	1150
31	1	2450	2400
35	1	3600	3600

TABLE II.

Females.

Nearest Age.	Number of Persons.	Right Temple.	Left Temple.
7	1	800	850
8	2	625	600
9	6	850	800
10	5	680	690
11	6	837	879
12	8	881	893
13	7	1115	1065
14	17	1294	1279
15	12	1735	1729
16	11	1302	1293
17	18	1562	1520
18	34	1624	1634
19	29	1700	1698
20	25	1682	1666
21	22	1939	1936
22	16	1834	1775
23	12	1708	1652
24	9	1661	1605
25	4	1437	1450
26	4	2087	2050
27	5	1990	1980
29	1	2750	2750
30	4	1862	1962
31	1	2300	2150
32	1	3000	2950

pain two sets of tests were arranged. The first series was carried out during the middle and last part of the school term, when the pupils were tired from their work, and the second series was taken during the first week after a ten days' vacation, when the pupils were comparatively fresh. The two sets of tests, called in the tables "first test" and "second test," were, in every instance, made on the same pupils. That this may be clear let me refer to Table III. In the upper line are the results from seven children, 10 years of age, whose right temples averaged 839 grams with 800 grams for the left temple in the first test. In the second test, immediately after the vacation, these same children averaged 1,239 grams and 1,192 grams for the respective temples.

The dynamometric test of the right hand, unless the subject was left-handed, taken each time just before the algometer was used, served as a basis for a comparison of the physical condition of each subject at the time of the two tests. A Narragansett dynamometer was used, and the measurements were in kilograms.

The results to which I now desire to call attention are found in Tables III and IV, which follow:

TABLE III.

Males.

Nearest Age.	Number of Persons.	FIRST TEST. Right Temple.	Left Temple.	Dynamometric test.	SECOND TEST. Right Temple.	Left Temple.	Dynamometric test.
10	7	839	800	18.4	1239	1192	17.2
11	8	987	940	20.2	1337	1156	20.1
12	5	1055	1025	24.	1650	1595	22.
13	11	1052	1036	26.7	1286	1236	27.
14	3	1466	1483	35.3	1491	1441	31.8
15	7	1432	1439	35.	1628	1560	36.7
16	10	1602	1582	45.1	1470	1457	40.4
17	10	1702	1700	46.	1737	1705	49.2
18	5	1780	1750	50.	1675	1640	51.6
19	10	1795	1710		1822	1760	
20	10	2180	2188	49.6	2017	1952	51.4
21	5	1980	1960		1860	1815	
23	5	2260	2140	54.2	2320	2245	58.4
24	3	1966	1950	60.	1450	1425	57.6
25	4	1750	1675	59.7	1393	1387	59.5

TABLE IV.

Females.

Nearest Age.	Number of Persons.	FIRST TEST. Right Temple.	Left Temple.	Dynamometric test.	SECOND TEST. Right Temple.	Left Temple.	Dynamometric test.
10	7	750	750	17.	987	962	22.
11	5	825	875	17.4	935	870	18.6
12	6	895	929	16.6	1220	1187	17.5
13	6	1152	1127	23.5	1322	1291	24.3
14	16	1300	1290		1307	1270	
15	9	1511	1505	30.8	1666	1750	25.1
16	11	1302	1293	27.9	1377	1340	29.4
17	12	1554	1514	25.8	1616	1562	30.3
18	22	1560	1573		1710	1669	
19	20	1551	1568	28.9	1763	1723	28.5
20	19	1627	1621		1536	1485	
21	17	1901	1902	33.1	1766	1717	33.4
22	8	1643	1625	33.2	1646	1603	31.8
23	6	1729	1737	31.8	1979	1933	32.1
24	7	1421	1400	34.8	1960	1892	35.7
26	2	1800	1750		2050	1937	
27	2	1850	1900	32.	2100	2050	32.5

An examination of these two tables shows:

1. That sensitiveness to pain varies at different times. It will be noticed, however, that the relation between the sensibility of the two temples remains about the same. The variation is regular. When the sensibility of one temple increases or decreases the other temple varies in the same way. The sensibility of the left temple is always a little more than that of the right.

The cause of this variation is probably to be found, in large part, in the bodily condition and in the degree to which the subject is affected by his bodily condition. In the present instance fatigue resulting from school work was undoubtedly an important factor in causing the variation.

2. Fatigue seems to have more effect on the younger boys and on females. The variation is more constant with these two classes. Their second test shows less sensitiveness in a greater number of cases. This is as might be expected, since the nervous system of children has a freer sway than in those who are older. Inhibitions play a less prominent part in the mental life of children. Hence they are more easily influ-

enced by their physical condition. Probably the same explanation may be made for the greater variation of females. Young men, being stronger physically, would not be so easily fatigued by school work. Table III shows that all the boys from 10 to 14 years were less sensitive to pain after the vacation than during the term's work, while Table IV gives only one group below the age of 20 years in which the girls were not less sensitive to pain after the vacation.

3. The dynamometric tests indicate that the physical strength of the subjects did not vary much when the two tests were made. As might be expected their strength averaged a little more after the vacation, but the difference was slight. It would seem from this that the comparative indifference to pain after vacation is to be accounted for by the increased tone of the body, and especially of the nervous system, rather than by any marked increase in physical strength.

In order to find out whether mental ability has any influence on sensibility to pain the pupils were divided into five groups, (1) very dull, (2) dull, (3) fair, (4) good, and (5) excellent. The advantage of this division over one of two classes, *i. e.*, "dull" and "good" or better, is evident. When we have to decide between "good" and "dull" we put a large number in the "good" group that do not properly belong there. Still we cannot call them "dull." Again "good" does not give us an idea of unusual ability, and so we are certain to put into this group a rather heterogeneous lot of intellects. If, however, we have a "fair" group below the "good" and an "excellent" above, we sift the pupils according to ability much more accurately.

Only those regarded as "dull" or "very dull," on the one hand, and "excellent," on the other, are included in the following estimate. Those designated by their teachers as "fair" or "good" were not considered. In this way a wide difference was made between the ability of those in the two groups.

TABLE V.

DULL.				EXCELLENT.			
Number of Persons.	Ages.	Right Temple.	Left Temple.	Number of Persons.	Ages.	Right Temple.	Left Temple.
Males.							
32	11–24	1849	1826	21	11–26	1641	1576
Females.							
51	11–25	1688	1671	32	11–30	1331	1321

It will be seen from Table V that those of "excellent" ability are much more sensitive to pain than those that are

"dull." Miss Carman[1] also found dull children less sensitive, though Dr. MacDonald says, "there seems to be no necessary relation between intellectual development and pain sensitiveness."[2]

The plan of putting all the "dull" pupils into one group, and all the "excellent" ones into the other, as previous investigators seem to have done, is subject to error because the majority of "dull" children is found in those ages in which "excellent" ones are rare, *i. e.*, from 14 to 18 years. The "excellent" pupils, again, are found among those up to 14 years and from 18 years on. As sensitiveness to pain varies with age up to about 18 years it is possible that this age variation might so far affect the variation due to ability as to seriously alter it. In order, as far as possible, to eliminate this error two groups were formed, one of "dull" and the other of "excellent" pupils, and for every "dull" pupil of a given age that entered into the one group an "excellent" one of the same age was placed in the other group. If in any case they could not be paired, the one for which a mate of the other grade of ability could not be found was excluded. To avoid any sort of selection I followed the rule of taking them in order, selecting the first "dull" or "excellent" among those of a given age and the next following of the other grade of ability of the same age. The result is as follows: Males (dull), right temple, 1,629; left temple, 1,618; (excellent), right temple, 1,585; left temple, 1,497. Females (dull), right temple, 1,533; left temple, 1,495; (excellent), right temple, 1,355; left temple, 1,360.

The same difference is evident here as was found in Table V. Those of "excellent" ability are much more sensitive to pain than those that are "dull."

Some thoughts of educational interest suggested by this investigation are:

1. The greater sensitiveness of young children. What has been shown here to be true of pain is also true of reproach and severity in whatever form. Pain is as much a mental as a physiological phenomenon.

2. More attention should be given by teachers to the physical side of education. Everything that lowers the bodily tone should be guarded against. The eye-sight of children, their hearing, food, play, cleanliness and sleep, ought to receive the teacher's attention, and care should be taken not to fatigue them by excessive school work or by keeping them too long at one thing.

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[1] *American Journal of Psychology*, April, 1899, p. 396.

[2] Further Measurements of Pain, December, 1898. Also Report of the Commissioner of Education, 1897-98, Vol. I, p. 1113.

3. The brighter children are more sensitive than the dull. Their nervous system reacts quicker in response to the action of the outside world upon them. Bright children present the difficult educational problems. Their more delicately organized nervous system makes it easy to destroy forever their intellectual possibilities. They need the greatest care and thought, and usually get the least.

4. Fatigue makes the nervous system irritable. When fatigued the brain's reaction is more reflex and less intellectual. The child cannot do his best work, and learns to be satisfied with a poor result. He may gradually accommodate himself to a kind of passive reflex nervous activity when his mind should be alert and discriminating.

STUDIES IN THE PSYCHOLOGY OF ALCOHOL.

By George E. Partridge,
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OUTLINE.

I.

PSYCHOLOGY OF THE INTOXICATION IMPULSE.

II.

EFFECT OF SMALL DOSES OF ALCOHOL UPON THE ABILITY TO DO MUSCULAR AND MENTAL WORK.

I.

THE PSCHOLOGY OF THE INTOXICATION IMPULSE.

§ 1. Introduction.

The problem which is outlined in the following chapter, is concerned with the nature and origin of the intoxication impulse, considered in its relations to the mental development of the individual and of the race. The interest in it grew largely out of a desire to know the value of the methods of psychology, as applied to the problems of ethics, for it seems likely that the next important step in ethics will be an appeal to psychology for an explanation of the motives which underlie conduct. Both subjective and objective methods are available in such studies. We can appeal to the introspection of the individual, and we can also infer the nature of mental action as expressed in conduct.

In regard to our present problem, the psychologist's work is (1) to gather facts about the intoxication impulse, as it is

felt, and as it expresses itself in the form of motor activity; (2) to study these facts in their relations to other known facts of normal and abnormal psychology. Apparently one of the most serious faults of method of the sciences which deal with abnormal man, is their tendency to study abnormalities without sufficient regard to the normal conditions from which they are deviations. Take for a single example the criminological method of the Lombroso school. To illustrate the dangers of it, it is sufficient to point to Nordau, whose conclusion that all society is pathological, is the logical result of the indiscriminate search for abnormalities.

It is the business of normal psychology, using both objective and subjective methods to present such a conception of mind as will prevent the dangerous and narrow minded tendency of regarding *all* departures from the so-called type as abnormalities. It must explain the origin of pathological mental variations, and study them as they occur in slight variations from the normal in borderland cases.

§ 2. Intoxication among Primitive and Civilized Peoples and among Animals.

In looking for the origin of an impulse so deepseated and so wide-spread as that toward the use of intoxicants, it is natural to turn to the drinking habits of primitive peoples. To present an adequate account of the use of stimulants and narcotics among them would require a volume. No attempt is made here even to classify or name the various alcoholic drinks which have been used, the purpose being solely to extract the main psychological principles. Alcohol drinking is certainly polygenetic. It has not spread as a custom from one part of the world to another, but is indigenous to many lands, and at various times. Primitive society presents one advantage over civilized society for the study of drinking customs, in that it is far less complex. Yet it can hardly be said that intoxicants have played a less important part among uncivilized than among civilized peoples. Indeed, it is hard to imagine what the religious or social consciousness of primitive man would have been without them. They have created gods; and about their use have crystallized myth and superstition, rite and ceremony in endless variety. State ceremonials, worship, marriage, the funeral, secular festivals, initiatory rites, dances, games, hospitality, care of the sick, preparation for war, consummation of peace, transaction of business, all have served as occasions for intoxication.

Religion. Excitement has often been regarded as an essential part of religion, and it has been induced in various ways as a means of divine worship; for example by violent movement, fasting, self torture and drugs. Epilepsy, chorea, hysteria, have

all been regarded as divine, and have been voluntarily induced. Long courses of training in practices which make the nerves crepitate have been believed to bring the soul into touch with supernatural things. So it is but a special instance of a general belief when intoxication is regarded as god-given or pleasing to the gods. For primitive man this belief was natural, for not only did the ecstatic feeling and sense of increased power suggest this view, but in the dreams which drugs produced, he seemed to enter his heaven and talk with his gods. It is a long way from the primitive soma worship in which all the devotees of Indra became intoxicated to please the god to the decent communion service of our own day; but none of the transitional steps are lacking, and probably this sacrament has a deep ancestral root in some of these early rites.

Suggestions of the use of intoxicating drugs by primitive man, for some purpose, possibly religious, are not wanting. Dawkins[1] speaking of the neolithic civilization in Europe, says that the poppy was cultivated, and that small round cakes have been found which may have been intended for use as a narcotic.

The earliest historical example of a religious cult founded upon intoxication was the soma worship of the Hindus. This has so often been described that a brief mention of it is all that is necessary. The god, Indra, was supposed to be present in the wine, as at a later time, was believed by the Greeks in regard to Dionysus. Both the Zend Avesta and the Vedas speak of a sacred plant, the fermented juice of which was employed in sacred rites. The Hindus believed that the performance of the soma ceremony was highly beneficial for both body and soul. They believed that Indra himself drank soma to obtain strength and victory in battle. They also attributed length of days to its use.

Religious intoxication cults are scattered all over the world among uncivilized people, and there can be little doubt of their independent origin at many times and in many places. A remarkable religious intoxication ceremony[2] has been described recently, which has spread from the Kiawi Indians and associated tribes which formerly ranged from the Arkansas River southward into Mexico, until it has become the chief religion of all the tribes of the southern plains. The ceremony usual takes place Saturday night and lasts until noon the next day. The men sit around the brightly burning camp fire, chewing the intoxicating mescal while a continuous singing and beating upon drums is kept up, interrupted by occasional prayers for the sick and by baptismal rites.

[1] Early Man in Britain, and His Place in the Tertiary Period, p. 293.
[2] Mescal Buttons. Prentiss and Morgan. Medical Record, 1896, I, 258-266.

The Pueblos, another race of American Indians, are described as a sober people who never become intoxicated except as a part of their religious ceremony. Featherman[1] describes a sacred festival of the Yakuts which is nothing more than an elaborate drinking ceremonial. Spencer says that the Dahomans deem it a duty to the gods to be drunk. The Ainos of Japan drink to the gods, as is also the custom of the Polynesians. In Fiji, drinking is accompanied by prayers or chants to the gods. The Patagonians pray to be eternally drunk in Heaven. Among the American Indians intoxication by tobacco was put to religious uses.[2]

Shamanism. A somewhat different religious use of intoxicating drugs is connected with shamanism, a cult practiced among a great many tribes in different parts of the world. The shaman uses various means for producing a condition of excitement in which he sees visions, prophesies, or drives out evil spirits and diseases. Epileptic or hysterical excitement is induced by wild and rapid movements, contortions, beating of drums, confusion, fasting, and drugs. In some cases long training is undergone to produce a nervous condition; young candidates are chosen from among the constitutionally neurotic. This widespread custom among primitive peoples suggests similar cults in the middle ages and in modern times in which various forms of nervous disorders, such as hysteria, epilepsy, chorea, convulsions, and ecstasies were voluntarily induced for religious purposes.

Among many other tribes intoxicants are used to produce this divine state. Among some tribes[3] in the Phillipines the shaman is usually a woman who works herself up to a state of frenzied nervous excitement by means of contortions and copious draughts of fermented liquor. Feasting and revelling follow, until oftentimes at her medicine ceremonies all present become intoxicated and fall into an unconscious state.

The Indians of California, Mexico, Peru and Brazil, all had drug ceremonies which vary in the drug used and in minor matters of form; but in their nature they are essentially alike. Dyer[4] says that the Darien Indians of South America give seeds of datura to children to produce a prophetic delirium in which they reveal hidden treasures. Information about their enemies was obtained in a similar way among other tribes.

Domestic life. There is no important event in the life of the savage which has not been especially celebrated by intoxica-

[1] Featherman: Social History of the Races of Mankind, Vol. IV, p. 249.
[2] See Spencer: Ethics, Vol. I, p. 441.
[3] Featherman: Social History of the Races of Mankind, Vol. II, p. 499.
[4] The Folk-Lore of Plants, p. 103.

tion. Any occasion which excites the emotions, whether it be joy or sorrow, seems to have demanded artificial means of intensifying the feeling. Birth appears to have been celebrated less than other important events of life, and there is comparatively little intoxication ceremony connected with it. Some New Mexican Indian tribes have a peculiar birth ceremony, celebrated only at the birth of a first child. In this the father becomes intoxicated, and in that state is surrounded by a dancing multitude who score his body until the blood flows freely.

The use of intoxicants in pubertal rites is very common, especially among the American Indians. The Tuscaroras[1] of North Carolina, among other initiatory ordeals for boys, administered to them several kinds of barks and stimulating plants which produced a state of intoxication. When the Creek[2] boys were to be initiated into manhood they gathered two handfuls of a certain plant "which intoxicates and maddens," and continued eating the bitter root for a whole day, and then steeped the leaves in water and drank from this decoction.

Marriage, aside from being among savage people an occasion of general festivity in which intoxication adds to the excitement, is also marked by special ceremonies in which fermented drinks play an important part.

Death is also celebrated by intoxication. Featherman says of the Lapps[3] that when a man is dying the friends gather around the bed in order to assist the passage of the soul into the next world. They drink brandy in order to produce an artificial excitement which causes them to weep. Funerals, as well as weddings, often close in general intoxication. Among the Urabas, of Nicaragua,[4] when a chief dies ceremonies are held around the grave for two days, carried on amid the excitement produced by intoxication. Among other tribes the dead are remembered by annual drinking festivals.

Social. To give a complete account of the relations of intoxicants to the social life of primitive man would be almost to give a complete account of the social life itself.

The American Indians furnish an example of the close connection of stimulants and narcotics with the very roots of the social consciousness. Although alcoholic drinks were used in many places on the North American continent, the great narcotic was tobacco, which, however, was used not for its soothing effect alone, but very frequently to cause violent intoxication. Its influence in the life and society of these peoples was very great. Abbott[5] says: "To know the history of tobacco, of the customs of smoking and the origin of the pipe would be

[1] Featherman: *op. cit.*, Vol. III, p. 128.
[2] Featherman: *op. cit.*, Vol. III, p. 161.
[3] Featherman: *op. cit.*, Vol. IV, p. 459.
[4] Featherman: *op. cit.*, Vol. IV, p. 459.
[5] Primitive Industry, p. 315.

to solve many of the most interesting problems of American ethnology."

Among some peoples drink ceremonies have taken on the importance of a state function. A very interesting example is that of the Seminoles[1] who prepared no intoxicating drink, but who indulged every morning in a tea known as the "black drink," a slightly exhilarating beverage, prepared in the public square for the whole community by a cook expressly charged with the duty. The taking of the black drink was considered a solemn act having both a religious and a military significance. Extraordinary powers were attributed to it. It was supposed to have a purifying effect upon their lives, and to efface from their minds all the wrongs they had unintentionally committed. It had the power of imparting courage to the warrior and of rendering him invincible; of binding ties of friendship and of exciting kindly feelings. They regarded it as a blessing upon them as a chosen people. A similar ceremony was performed by the inhabitants of the Tongas.[2] When they arose at break-of-day the higher classes met for a drinking bout, kava being served. The taking of kava was always attended with tedious ceremonial forms and the strictest observance of etiquette. The whole community generally assembled. The common people were considered merely as spectators. A kava party was regarded as an essential part of any state affair.

Among the Creeks the taking of war physic was of the nature of a state ceremonial.[3]

We can sum up the social aspects of drinking among primitive peoples by saying that every event in the community out of the daily routine, which brings the people together, is likely to be the occasion of intoxication.

Periodic drinking. One cannot help noticing on examining the anthropological literature that the drinking of primitive peoples has a tendency to be periodic. The statement is frequently met with that tribes who are usually sober and industrious, on occasions indulge to great excess. The examples, of which the following are typical, are very numerous.

"The amusements of the Guatamalans[4] are less common and varied than among the whites, and are generally reserved for special occasions when all indulge to excess. Reunions with dancing are the common form of these amusements. Drinking is inseparable from them, and they do not usually break up until all have attained the climax of their wishes, becoming helplessly drunk."

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[1] Featherman: *op. cit.*, Vol. III, p. 170.
[2] Featherman: *op. cit.*, Vol. II, p. 115.
[3] Featherman, *op. cit.*, Vol. III, p. 164.
[4] Featherman: *op. cit.*, Vol. III, p. 550.

"The Maricopas tribes of the Pueblos[1] indulge once a year in a drinking bout, which continues from one to two weeks.

"The Dyaks of Borneo[2] celebrate numerous festivals of a quasi-religious character. The head feast lasts four days and four nights and a general state of intoxication closes the solemn ceremony.

"The Pueblos[3] get drunk once a year, the revelry continuing for a week or two at a time. But it is also a universal custom among them to take regular turns, so that only one third of the party is supposed to indulge at once. The remainder are required to care for their stimulated comrades and prevent them from injuring each other or being injured by other tribes. Some of the Pueblos' dances end with bacchanalia in which not only general intoxication but promiscuous intercourse between the sexes is permitted.

"Once a year the Keres[4] have a grand drink feast and dance. They pass the night in indulgences of a most gross and sensual description."

"The Mosquitos[5] have drinking bouts which last for days. At this large numbers assist in draining the canoe full of liquor prepared for the occasion. Occasionally, surrounding villages are invited and a drinking bout is held, first in one house then in another, until the climax is reached in a debauch by both sexes of the most revolting character."

"The Gonds[6] of the central provinces of Hindostan are of an unsteady temperament. They are industrious and work laboriously for a time, but during certain intervals of repose they abandon themselves to unrestrained dissipation, and squander the scanty gains they have earned. They believe that they have divine permission to sing, laugh and drink according to their hearts' content."

The statement that has often been made that no tribe has existed without its stimulant or narcotic, probably cannot be substantiated. It is true, however, that there is no large area of the earth's surface without its intoxicant. E. H. Man[7] says that in the Bay of Bengal, prior to the advent of the whites, the natives were ignorant of narcotics in any form. The Fuegians are said to have no intoxicating drinks of any kind, confining themselves exclusively to water. Several nations of American Indians, among them the Hurons, Chinooks, California Indians,

[1] Featherman: *op. cit.*, Vol. II, p. 279.
[2] Featherman: *op. cit.*, Vol. II, p. 350.
[3] Bancroft: Native Races, Vol. I, p. 550.
[4] Bancroft: *op. cit.*, Vol. I, p. 551.
[5] Bancroft: *op. cit.*, Vol. I, p. 706.
[6] Featherman: *op. cit.*, Vol.IV, p. 115.
[7] Andaman Islanders, p. 44.

the Shoshones, the Natchez and the Seminoles are all credited by either Bancroft or Featherman with an ignorance of alcohol in any form. Some tribes of Indians on the river Ariare, in New Granada, South America, are said not only to have no intoxicant of their own, but to refuse the stimulants of the whites.

Temperance. Primitive man was not wholly devoid of ideas of temperance. Certainly among the historical relics of the early civilizations frequent reference is made to the evils of drinking to excess. Laws were enacted and punishment inflicted for excess in drinking among many peoples. The worshippers of soma thought that all other liquors caused evil effects, and therefore prohibited them. Drinking is prohibited to women and lower classes among many peoples. One form of intoxicant is sometimes allowed to one class, while other classes use a different drink. Spencer thinks that temperance arose as self-control in order to offer libations to the gods. Though the idea of temperance may have originated partly in this practice, there is no reason to believe that this was the most important cause. Other factors enter, such as observation of its evil effects. The difference in the drinking of man and woman doubtless had an origin largely in the differences of mental activity in the two sexes. Later, no doubt, an increasing consciousness of, and respect for, the self was a cause of restraint (probably a very strong psychological motive for temperance at the present time). An increasing interest in general self-control as an ideal is probably the most potent factor of all in the development of temperance.[1]

Conclusions. Among primitive peoples, the use of intoxicants, although not quite universal, is so general, that exceptions are noteworthy. Intoxication seems to have originated in connection with the religious and social consciousness. Probably the use of fermented drinks originated in this way, and the use of them as beverages came at a later stage. A rather careful examination of the anthropological literature leads to the conclusion that taste was not much concerned at first. On the whole, primitive man is not a steady nor habitual drinker. He drinks alcohol occasionally to secure intoxication, his drinking is likely to be periodic, and in general it is characterized by great excess and uncontrolled excitement.

Intoxication in early civilizations. The history of intoxication among the civilized nations has for the most part been sufficiently treated by others. The best account is to be found in Samuelson's "History of Drink," and reference is made to that work.

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[1] See § 8.

Samuelson says that in every nation there was a period just previous to the time of highest culture when intoxication was exceedingly prevalent, and that again in the degenerate days after the highest point of culture was past there was a second period very similar to the first. In China there was an early period of gross intemperance. Mensius, a disciple of Confucius (about 500 B. C.), mentions drunkenness and speaks of the excessive use of wine in the sacrifices. But this appears not to have been a very frequent sin in his day. Long before that, however, the Shooking or history and the Sheeking or book of ancient poetry speak of an edict against drunkenness said to have been promulgated about 1100 B. C. It seems that drunkenness had taken such a hold upon the people as to threaten the ruin of the nation. In India, also, there was a period of great prevalence of intoxication, for the soma and sura play a very important part in the history of the early period. It is evident, also, that at one time drunkenness was not looked upon with disfavor for Indra was believed not to be capable of any great deed unless he was intoxicated.

Among the western nations Greece affords, in the worship of Dionysus, the best example of a religious cult growing out of the intoxication impulse. In its earliest form the Dionysiac worship appears to have been merely dancing and singing around the altar of the god, accompanied by intoxication; but with all the revelry there was an air of solemnity and reverence. It was later that there came to be in connection with this worship nude and sometimes indecent processions. In these the spirit was one of abandonment; slaves were given brief liberty and general drunkenness prevailed; Bacchus was represented, accompanied by women frenzied with drink or excitement carrying cymbals, dancing, and singing songs in honor of the god. In one of the celebrations performers, women and girls called Mænades, took part; orgies were held at night in the mountains; there were blazing torches and the wildest excitement prevailed.

The cult and symbolism of Dionysus have been variously interpreted. Nietzsche[1] says that the Greek conception of Dionysus was as the key to the mystery of life. The fundamental Greek instinct was revealed there. The meaning was the triumphant affirmation of life over death and change. Nietzsche finds also a very close relationship between sex and intoxication. Taylor's explanation of the Bacchic and Eleusinian mysteries is based upon its symbolism.[2] "They were considered for

[1] This and the following abstracts from Nietzsche are from Ellis: Affirmations.

[2] Taylor: Eleusinian and Bacchic Mysteries.

two thousand years or more," he says, "the appointed means of regeneration through an interior union with the divine essence. They were symbolic of the death of the old life and the birth of the new. The lesser mysteries occultly signified the miseries of the soul while in subjection to the body, the greater obscurely intimated by mystic and splendid visions the felicity of the soul here and hereafter when elevated to the realities of intellectual vision." The symbolism here signifies a higher consciousness and a more abundant life.

Whether a merely noetic explanation is sufficient to account for the form of these rites, they certainly originated in the emotions, and it is equally certain that pessimism and a craving for relief of pain were not the motives. Nietzsche touches the right key when he says that the Dionysia expressed a fundamental instinct of the Greek life. Music, the dance, intoxication, revelry, all united here under the guise of religious fervor to express the natural exuberance of life which was characteristic of this civilization.

Their poetry expresses this deep feeling element in no uncertain tones. Farnell[1] says that the dithyramb began here in the wild ecstatic song sung by wine-flushed revellers. Mure[2] expresses the same view when he says that everything leads to the belief that the proper characteristic of the Bacchic dithyramb, especially as remodeled by Arion, was like that of the god and his worshippers an exuberance of jovial excitement. Nietzsche discovers here, also, the origin of Greek art in two impulses, one starting in the phenomenon of dreaming, which he associates with Apollo, and the other starting in the phenomenon of intoxication associated with Dionysus. Tragedy is the outcome of Dionysiac music fertilized by Appoloniac imagery. Perhaps at no time in history has the inner growth force been so well exemplified and so fervently worshipped as in the early period of Greek civilization. The spirit of intoxication, as it was expressed in the Dionysiac cult, was one form in which the growth-impulse found vent in consciousness. The feeling which is expressed is a craving 'for life and for life more abundant.'

Intoxication among animals. Animal psychology has little to offer in the way of facts which bear upon the subject of the intoxication impulse, and the few facts which are well authenticated are difficult of interpretation, especially those in regard to the habitual use of alcoholic drinks by animals. Apparently animals are affected by alcohol in much the same way as men

[1] Farnell: Greek Lyric Poetry, p. 102.

[2] Mure: Critical History of the Language and Literature of Ancient Greece, Vol. III, p. 88.

are. Romanes[1] made experiments upon jellyfish, starfish and sea-urchins. The first effect upon Sarsia is to cause a great increase in the rapidity of swimming movements, so much so that the bell has no time to expand properly between the occurrences of the successive systoles. These motions gradually die out, and finally the animal is no longer responsive to stimuli applied to the tentacles. As to how the animal feels, whether he enjoys this experience and desires to repeat it, probably no one would venture to say. Dogs under the influence of large doses of alcohol show signs of apparent exaltation, in which motor activity and expressions of social feeling are increased, followed by stages in which there is depression and fear, and the animal skulks away and hides. Wasps have been observed in a state of intoxication after attacking over-ripe fruits. They get very drunk, crawl away in a semi-somnolent condition and repose in the grass until they recover, and then go to the fruit again. When thus affected they are said to do their worst stinging. Stories are told of elephants, apes, and dogs which have acquired a taste for alcoholic liquors. The fox terrier, a favorite among sailors, is often credited with a craving for alcohol. But in general such stories lack corroboration and there is always uncertainty as to the psychological interpretation of the facts. There is no doubt that dogs can be trained to drink beverages which contain alcohol, perhaps to like them; but it is impossible to determine in any case whether taste is all that is involved, or whether the animal is capable of forming such a complex association as to like a drink which is disagreeable in taste for the sake of a remote psychic effect, which is certainly the case with the human subject. Darwin[2] relates cases of baboons being made drunk with beer. The next morning the keeper found them holding their heads tightly, but when offered beer they refused to taste it again. One is tempted to say at first thought that the baboons remembered their disagreeable experiences, and objected to repeating them. But a more probable explanation is that they had a sensation of nausea, at the sight or smell of alcohol. Perhaps they would have refused food also. Dogs will readily drink sour beer and become intoxicated. Hens and chickens will devour eagerly bread soaked in whiskey or brandy. There are stories about dogs which prefer beer to meat. In the first two cases we cannot assume anything except taste, in the case of the dogs we cannot assume that, for there is another factor—training. Dr. Hodge's dogs have never shown a taste for alcohol during more than a two years' course of experiments, in which it was given

[1] Romanes: Jellyfish, Starfish and Sea-urchin, p. 227.
[2] Darwin: The Descent of Man, p. 7.

to them daily in rather large doses. One of these dogs after scenting a bottle of alcohol retired to a corner and refused to come when called again. This was after the two years' course of experiments. In her case, however, the dose had never been sufficient to cause intoxication.

So far as these facts go there is no evidence that animals learn to appreciate the state of intoxication or acquire a craving for alcohol. Although the matter is open to definite experiment, facts, even if obtained experimentally, would be difficult to interpret.

§ 3. The State of Intoxication.

Comparative effects of intoxicants. The drugs which are commonly used for intoxication purposes, though differing greatly in chemical composition, can be grouped into a single class, when they are studied with reference to their physiological effect. They are all stimulant-narcotics (Anstie), that is to say, when taken in small doses, or as an initial effect of large doses, they stimulate the nerve cells. Large doses invariably produce narcosis. It is true of most, if not all of these drugs, that, whether applied to a single nerve fibre, or to the nervous system as a whole by way of the circulation, they produce first a stage of increased excitability followed by a stage of lessened excitability. The mental effects are analogous—a stage of exhilaration is followed by a stage of depression.

A still wider generalization may be made. All poisonous substances which finally destroy the nervous tissue cause an initial stage of increased excitability. But, inasmuch as we have at the outset restricted the discussion in this paper to the psychological aspects of the subject, it is unnecessary to more than refer to the physiological problems involved. There has been much discussion as to the nature of the physiological and chemical processes of stimulation[1] and excitation, but little is surely known. The synonymous use of the two words has added much to the confusion. It is probable that there is a wide difference between increase of normal function, and increased excitability or irritation which may be regarded as an expression of the active resistance of the nerve cell to a poison,

[1] Stimulation, according to Anstie, is an increase in the *normal* functions of the nerve cell. Narcosis is paralysis of these functions. Most of the phenomena of excitement which occur in intoxication he says, are due to narcosis and not to stimulation. Many writers at the present time would deny that alcohol ever exerts a stimulating effect, in the sense of the word as used by Anstie, but class all its effects under the general head of narcosis or paralysis.

For a full account up to its date, see Anstie: "Stimulants and Narcotics;" also the works on materia medica and therapeutics, *e. g.*, Wood, Brunton; also standard works on poisons.

or even as a stage of paralysis. The physiological changes in the different stages of intoxication are quite unknown. Some think that paralysis of controlling brain cells can account for the increased mental activity; others think that the effect is upon the cells directly involved in the activity.

There are many interesting but for the most part popular accounts of the mental effects of the stimulant-narcotics. De-Quincey's "Confessions of an English Opium Eater" set the style for much of the literary treatment of the subject, and also popularized the use of drugs among writers for the purpose of exciting the imagination. Although in all these accounts some allowance must be made for exaggeration, their points of general agreement must be given due credit. There have also been made a considerable number of experimental studies upon intoxication which are of interest to psychology. Weir-Mitchell, Prentiss and Morgan, Delabarre, and others, have recently done experimental work with drugs.

It is the common testimony that in drug intoxication, the normal limits of both pleasure and pain are passed. Delabarre[1] says, that, as an effect of hasheesh one gets a larger idea of the range of the emotional life. The various forms of intoxication are nearly, if not quite always a succession of emotional changes, in which exhilaration accompanied by a free flow of thoughts, is followed by depression and decreased associational power. Frequently mentioned effects of drugs are the awakening of early memories, exaggeration of emotional states, changes in time and space perceptions commonly referred to as a "feeling of infinity," fantastic color visions, confusion of hearing and vision, animistic beliefs, philosophic insight, double personality, sensations of extension of the body, increase of personality.[2]

Experiments with intoxicating doses of alcohol. Experiments which were made by the present writer upon four subjects with intoxicating doses of alcohol, show that until the intoxication is well advanced the rapidity of simple mental processes was not greatly decreased. Adding, the memory of nine place figures, rapidity of tapping, strength of hand clasp, estimation of distance and of time, clearness of vision, were not seriously interfered with until muscular inco-ordination became extreme. The rapidity of tapping was most affected. Ability to control a reflex wink was greatly increased by the alcohol. A study was made also of the effect of intoxicating doses of alcohol upon the association of ideas. A list of 400 words was given to the subjects once on a normal day and then again two weeks later,

[1] Paper read before the American Psychological Association, New York, 1898.

[2] These statements are summarized from 60 cases gathered from the literature.

during the stages of a progressive intoxication. A single reaction to each word was required and the time was not taken. Comparing the two series of normal and alcohol reactions it appears that in the case of each subject there was a progressive dissimilarity in the two series which reached a maximum and then decreased as the effects of the alcohol passed off. The most noticeable change in association was the increase in the egoistic associations due to the alcohol. In one case the visual associations were increased. The chief effect upon consciousness was a succession of changes in the emotional tone. In all cases a stage of exhilaration was followed by a stage of depression and melancholy which in turn gave way to the normal condition. In two cases a second stage of exaltation followed the melancholy stage, but this was not so clearly marked as the first period. The emotional changes seemed to dominate the changes in the character of the associations. In each case there was a very clearly marked moment in which there was a feeling that control was being lost, accompanied by a desire to throw off all restraint and give way to the feelings.

In regard to the theory that the nerve cells are affected by alcohol inversely to the order of the acquirement of their function, our data rather confirm than contradict the statement, so far as it relates to motor development. Ribot[1] states this view somewhat as follows: 'At first there is an excitement, the very antithesis of reflection. Attention as a result of a motor convergence can no longer exist. Next the control of the tongue is lost. A man tells all his secrets; the will under the higher inhibitory form has disappeared. After this he becomes incapable of any continuous plan of action. Then the will, even under its lowest or most impulsive form, becomes powerless. Then the most delicate voluntary movements, those of speech and of the hands, cease to be co-ordinated. One degree lower he loses the semi-automatic movements, those of walking; then muscular tonicity weakens, he falls from his seat; then reflex movements are abolished, finally there is a cessation of automatic movements, those of respiration and of the heart.'

Conclusion. Examination of the literature of intoxication, and the experiments show that the pleasure of the state is due in part to the wide range of emotional tone. The changes in association appear to be dominated by changes in the emotions, the physical bases of which changes are quite unknown. For the present purposes, however, it is unnecessary to know their nature. The experiment upon the reflex wink, and common observation, both show that the feeling of personal safety is increased in the pleasure stage of intoxication. The falling

[1] Psychology of the Emotions, p. 424.

away of the sense of propriety which occurs in intoxication is illustrated by one of the cases studied. During the first two rounds of tests the subject (who is naturally very careful) was very exact in observing all the conditions of the experiment. In the later tests he showed an increasing carelessness and confidence. The psychological changes show an increased activity in those sensations, emotions, and associations which make up the self. The increased social feeling evidently depends upon these changes and is secondary. This is borne out by popular testimony as, for example, that those exhilarated by alcohol are better talkers than listeners. The two important conditions of social comfort are self-confidence, and (perhaps as a result of this) freedom from suspicions in regard to others. These factors differ greatly among individuals, and in the same individual they are subject to fluctuations due to physiological and other conditions. Just how alcohol produces these psychical conditions, whether by removal of certain recently acquired associations, or entirely by more general changes in the emotional tone, it is quite impossible to determine. The intimate relation of intoxication to the social impulse undoubtedly accounts in part, at least, for the widespread and persistent use of intoxicants, especially among primitive peoples. Doubtless it made possible wider social relations than could otherwise have been maintained in many cases where suspiciousness due to manner of life or to temperament tended to prevent free social life.

§ 4. A Study of Cases of Inebriety.

People who use alcoholic drinks to excess may be divided into two classes, dipsomaniacs and drunkards. The former are periodic drinkers, and true dipsomania is now generally recognized to be an indication of some form of nervous disease. The drunkard is the steady drinker, who, in general, drinks whenever he has opportunity, but drunkenness may take the form of sprees without becoming a true dipsomania. A study of various classifications of drinkers discloses the fact that there are two general types of organization which predispose to drunkenness. One is the undeveloped type, intellectually, morally, and physically of a low order. It represents a low stage of culture in which habit and ideals do not clash. The second is the degenerated type. People of this type commonly possess the craving for intensity of consciousness, which goes with culture and high ideals, but lack balance. To this class belong many men of genius who seem to crave strong excitement. But, applied to individual cases, such generalizations are unsatisfactory, and there is no more perplexing problem in individual psychology and physiology than is presented by the subtle dif-

ferences of organization, which make it possible for one man to drink moderately, without danger, while another, apparently as well constituted and as favorably conditioned, perishes in the presence of alcohol.

Dipsomania is full of interest to psychology. On the mental side it is a recurrent impulse to become intoxicated. During the intervals there is no desire for alcohol, and usually aversion. Its rhythms are especially interesting. Howard says that he believes the long rhythms in nutrition and heat regulations of the body are factors in augmenting and aggravating the periodicity of dipsomania. Monthly rhythms of the female are often accompanied by attacks of dipsomania. The season of the year seems also to exert a minor influence in inebriety. Crothers says that inebriety is more marked and more impulsive in the spring and early summer months. In a thousand cases of inebriety ninety-four drank to excess in April, May and June, and at no other time of the year.[1] In women the commencement of dipsomania very often dates from menstrual disturbances, from pregnancy, and from the menopause. The attacks of dipsomania are usually preceded by disturbed mental action and control. Before an attack the dipsomaniac is irritable, and there are other signs of nervous disturbance. When alcohol cannot be obtained there is restlessness, indefinable horror as of some impending danger, the throat is parched, the skin hot and dry, the pulse rate is increased.

These are the main facts of dipsomania. For more extended accounts reference must be made to the psychiatrical treatises, such as the works of Krafft-Ebing, Kräpelin and others. Also to numerous articles in the *Journal of Inebriety*.

Below are given extracts from sixty-five cases of inebriety, studied by the present writer largely to determine the nature of the craving for intoxicants as it is felt by the inebriate. Most of the men studied were confined in criminal institutions. A few were voluntary patients in inebriate asylums. For the most part the conversational language of the subject is retained.

Case 1. Man, 25. Drank since 15. Used a quart of whiskey a day for years. Has drunk alone, but generally likes to drink in a crowd. No craving for it at all while in jail.

Case 2. Man, 31. Drank his first glass at 24. Drinks socially altogether. Is drunk every Saturday night. No craving for drink now or during the week when he is out. When tired and thirsty one glass of beer tastes good. After that it is not the taste. He drinks for the feeling, or because he has lost control, and does not care what he does. Afterwards feels the disgrace keenly. He is strong, of athletic build, and in perfect health so far as he knows.

Case 3. Man, 36. Always drinks in company. Never intends to get

[1] Crothers: The Influence of the Seasons on Inebriety, *Quarterly Journal of Inebriety*, July, 1897, Vol. XIX, pp. 315-316.

drunk when he starts. Occasionally between drunks will take a glass of beer. Trouble will always make him get drunk. When in jail feels the loss of his pipe, but does not feel the loss of his drink. As a boy, was very bashful. Would always take a few drinks before going to a party or social.

Case 4. Man, 38. Been drinking since 16. Very seldom drinks alone. Has no appetite for it here, and does n't see why it can't be the same outside. If he succeeds in going two or three weeks without drinking, he does not crave for it.

Case 5. Man, 52. Been drinking since 16. For the last few years has drunk very heavily. Drinks mostly in company. Drinks because he worries. Has n't missed liquor at all since he came here. Misses his tobacco some. Is of a nervous temperament, always was nervous. Thinks he is not going to drink any more.

Case 6. Man, 21. Been drinking since 14. Has drunk alone a good deal. Likes to be alone when drinking. Has drunk as many as thirty glasses a day. Had been drinking heavily when arrested, but missed the liquor for two or three days only. Takes more to make him drunk than when he began drinking.

Case 7. Man, 43. Been drinking since 20. If he takes one drink is sure to take another. Does n't like the taste of beer nor liquor. It is for the feeling after it is down. If there was no rum, would never have any longing for it.

Case 8. Man, 32. Very hard drinker. Does n't care for the taste of liquor at all. Does n't care anything about it until he gets into company. Never goes into a saloon alone. If worried about anything goes out looking for company, and drinks. In jail, does n't crave either liquor or smoking. But does crave chewing tobacco.

Case 9. Man, 43. Of melancholy temperament. His drinking is periodic. Always drinks alone. When he drinks with a crowd, he spends too much money. Will go for two or three months and have no desire for it at all. Went a year without touching it. Is quite sure he is never going to drink any more.

Case 10. Man, 50. Been drinking since 16. Has never had any craving for drink. Never thinks of it when in jail. Does not like the taste of whiskey or beer, or any other kind of liquor. Never goes in to drink alone, even when he has money. He never goes in because he wants a drink.

Case 11. Man, 48. Been drinking since 19. Does n't like liquor. Never goes in to get a drink by himself. Drinks by sprees. When he meets two or three old friends, he likes to go in and talk over old times, and thus gets drinking and can't stop. Misses the tobacco more than rum. A man does n't need rum, he does need tobacco. Is sure he is not going to drink any more.

Case 12. Man, 43. Been drinking since 25. Does n't like the taste of liquor. No craving for it, now or ever. But cannot take a glass or two and then stop. Always gets drunk when he drinks at all. His health is good and he is not nervous.

Case 13. Man, 40. Drinking since 17. At 30, commenced to use whiskey altogether. Always drank alone and every day. His usual allowance was fifteen or twenty glasses in a day. Four years ago he stopped for a year after taking a six weeks' treatment. Has no craving for alcohol now whatever, but there is a struggle all the time against depression and fatigue. If he has n't had anything to drink for a month or two, he does not crave it at all.

Case 14. Man, 18. Never likes the taste of liquor, except after he has been drinking heavily. For three or four weeks after coming to jail he craved both liquor and tobacco. Now he does not think of either.

Case 15. Man, 36. A sailor. Drinks nothing when at sea. Misses

it the first two or three days out. Since he has been in jail has missed his pipe, but does n't care for drink. He never drinks alone. Does n't like the taste of liquor, it is the sensation.

Case 16. Man, 35. First drink at 14. The only craving is on a hot day when thirsty, then he really feels a craving for a glass of beer. It is impossible for him to drink moderately now. When he drinks he always drinks too much. When he has n't had a drink, he does n't want it. When he has, he wants more. Is in perfect health, so far as he knows.

Case 17. Man, 24. Does n't like the taste of whiskey nor crave it, but when he once takes a taste of it, can't stop short of extreme intoxication. Is never tempted to drink except when out with the boys.

Case 18. Man, 26. Has been drinking since 20. After he has had one drink, he has a strong craving for more. Otherwise he has no taste for it whatever, and never thinks of it except when he is where there is excitement and drinking is going on. To have a good time is the starting.

Case 32. Man, 23. Has no craving for liquor. Once in a while drinks alone, but never intentionally to get drunk. Likes the taste of whiskey. When with a crowd, does not feel as if he was having a good time unless he drinks. If he takes one drink, he always gets drunk.

In fifty-eight of the sixty-five cases studied, there is no evidence of a conscious craving for alcohol, although most of the men who were questioned are confirmed drunkards. Nearly all are recidivists. One has been sentenced sixteen times for drunkenness. The statement that after liquor has been for any reason cut off for a period of from ten to twenty days the craving ceases is so frequent in these cases that it must be regarded as expressing the true mental attitude toward drink of a class of people who are commonly considered incurable drunkards. In the six cases which follow there was some evidence of a craving for alcohol.

Case 19. Man, 49. Unmarried. No nervous disease or insanity in the family, so far as he knows. His father died at 76, of old age; mother at 50, of pneumonia. He has six brothers and sisters, none of whom drink. He, himself, has always been healthy. Left school at 14, was a good boy, always went to church at that time. His first drink was taken at 16. Used to set up ten-pins in a bowling alley. Drank beer there, drank beer altogether for a long time, before he began to use stronger drinks. Never drank for the taste. In general, his drinking has been to create a false spirit when he is down-hearted. He has never been in the habit of drinking daily; for years, his drinking has been by sprees. Between drunks he would not drink at all; has tried very hard to overcome the habit. Thought it was wrong and that it was hurting him. Would fight it for five or six days, but sooner or later would get in with the boys. Of late years he has drunk alone mostly. Went without drink altogether for two years, from 1876-78. At that time was working for good pay and simply made up his mind to stop drinking and succeeded.

Every month for the last seven years, he has spent two days drinking, and three days recovering from it. In this he has been perfectly regular. He has taken asylum treatment to no avail. Although, during all these four years, he has never once missed a week's drunk, he thinks that if there had been no way of obtaining liquor, he never

would have craved it. He has no craving for it now at all, and does n't even think of it. But when he was working, every Saturday he would think of it all the afternoon, would go home in the evening, change his clothes and go down town. He would walk around until about eight o'clock, and then would go in and get a glass of beer; that would be the beginning of drinking, which would be kept up steadily until Tuesday. He knows of no cause for his drinking, cannot in any way explain the impulse, which is entirely beyond his control. Never left the shop Saturday without fully intending to stay sober. Each time determines never to touch another drop. He feels that there is some peculiar weakness of his nature, and thinks that even in the absence of liquor, he would have found some other way to ruin himself. Again he says that he feels quite convinced that he is never going to drink any more. As a child, he was restless and uneasy, of vivid imagination, quick tempered, but honest and truthful. Never cared much for society of the other sex.

Case 20. Man, 38. Only child. Father living, now 80. A periodical drinker. At 11 was made drunk, was taken home by two men. Does n't remember feeling sorry about it. As a child was very nervous and high strung. He has been a periodic drinker since he was 17. At 32 he broke his leg, and at that time began to use morphine to kill the pain. Has used it ever since. Morphine makes him feel dull; it is quite different with alcohol. A little makes him thrill all over. The least taste of alcohol will set him going, even sweet cider, unless it is just out of the press. Morphine he uses now after he has been drinking heavily. It sobers him, makes him fall asleep, and puts an end to his spree. His periods are usually precipitated by meeting a friend. Meeting an old comrade affects him in a manner which he cannot explain. He is inclined to be very intense, both in his likes and dislikes. He hates the taste of drink of all kinds. His periods come now at intervals of from three months to a year. He went once two years without drinking. Many times he can control the impulse, but is very easily and strangely influenced. He feels that he will control his appetite altogether sometime, but expects another attack when he gets out this time. He thinks he is safest when he is where liquour can readily be obtained; when away where he can't get it, there is likely to be an increasing craving. Periods are most likely to come on at times when he is despondent or depressed. He is by nature of an unstable disposition, loves frequent change, has worked at almost every trade. As a boy he had plenty of money, a good education, and never expected to have to earn his living. He feels keenly the disgrace of his condition.

Case 21. Man, 34. An actor. Good health, no nervous disorders. His first drink was at 12. Was out skating on a cold night and drank cherry brandy. His next drink was taken at 17. He was working in a bank, came down town too late for breakfast, ordered a glass of beer. He was alone. After this he drank more or less, socially. He was occasionally drunk, but only at times of unusual festivity, as at New Year's Day and the like. Was married at 21. From 21–27, drank rather steadily, but only in a social way. At 27 he parted with his wife. After that he drank to excess in order to forget. Drank alone altogether, and continually. Rented a room and began a spree which lasted for six months. During that time there was not a day that he was sober. Since then his drinking has been somewhat periodical. Went West to work on a ranch, and went eight months without liquor. He was where he could not get it conveniently and had no craving for it. Was offered drink a few times during that period, but refused. Lately, his sprees have been more frequent. Sometimes he can go for weeks and drink more or less moderately, but invariably ends in an

uncontrollable spree. In 1893 he spent four weeks at the Keeley Cure, from that time to February 1896, he went without drink. His sprees always last as long as he has money or can get whiskey. As regards the craving, when he has n't been drinking, he does n't crave liquor, but when he has once started, the need is imperative. He has no craving since he came to the inebriates' home, although he has not been under restraint. Thinks that if he lived all the time in such an environment, he never would think of liquor. The craving is more of a mental than a physical craving. It is a desire to get away from himself. The craving for drink is a craving which any other pleasure equal in degree would satisfy. It is a disgust with present conditions and a desire to cut loose from old ruts and have a change. Of late his sprees have always been preceded by a fit of despondency. Look, ing back, he can trace two quite different conditions, which are likely to initiate a period of drinking: one is depression, and the other is unusual success. The nature of his mental condition during a spree differs greatly according to the mood in which it starts. If he starts in a happy mood, he is jovial all the time; if he starts drinking when he is depressed, he is unsocial and silent, and there is no stage of exhilaration. He does not feel at all sure that he is cured. One might as well ask him whether he ever intended to have pneumonia again. It is a thing which he does not control.

Case 22. Man, 45. Father died at 65 of kidney trouble. Mother living at 70. One brother and one sister, both died young. Was 17 when he took his first drink: it was at a wedding. After that drank steadily, and his drinking was periodical from the start, his sprees occurring at intervals of from three to six months. The longest interval was a year and a half, when he was 38. At that time he was a member of a reform club. During all that time he never had any craving for liquor whatever. Excitement and association broke the spell. His periods are induced usually by associating with people who drink, or by misfortune, or anger. He does not like the taste of alcohol nor crave it. But if he gets to drinking cannot stop. He has been arrested eight or ten times, each time for drinking. When drunk he is peaceable and jolly. He never drinks alone. Probably never drank 25 drinks alone in his life. He never cares for drink unless there is excitement, and there is no excitement when a man is alone. Says he cannot remember a day in jail when he ever wanted a drink. He craves tobacco, however, and gets so nervous craving for it that he could almost chew iron. He does n't feel sure that his drinking is permanently stopped. He thinks confinement has no effect, for a man can't be cured by loneliness, the only way is to keep him away from drinking society.

Case 23. Man, 38. Born in Ireland. For the last 28 years he has been drunk about once a week. When he is out of jail has a craving for drink, it is like a gnawing in the stomach, as though he wanted something to eat. Is thinking of it all the time until he gets a drink. Never thinks of it at all when he is in jail. Tobacco he craves. Would think of the whiskey, too, probably, if there was any chance of getting it. It is the thought of it which puts the appetite down into the stomach. Has taken the pledge a good many times, and kept it once a year and a half, fifteen years ago.

Case 24. Man, 40. Is nervous, weak and emaciated. Suffers from insomnia. Says that he does n't know of any worse drunkard than he is. Left school at 15, first drink at 18, was out with a crowd of boys and took two glasses of beer. Has never been able from the very start to drink moderately. Still he thinks he has no craving for it when he has not been drinking. Never cares for it when alone except after drinking, then he would walk five miles to get it. Managed to stop for a few months once, but got out with the boys again; thought that

he could drink moderately, but was soon as bad as ever. His sprees usually last until he gets out of money, sometimes he drinks almost continuously for two weeks. Never thinks of the liquor when he is in jail, craves more for the tobacco. Thinks he has been getting worse lately; the excitement and exhilaration after drinking is less, he seems soon to lose his mind and can remember but little afterwards. He has frequently signed pledges, and once or twice has gone three or four months without drinking. Means to do right, has sworn time and time again never to drink any more. The craving for liquor, as he feels it, is hard to describe. He recognizes it as a kind of hankering and worrying, it is entirely different from the craving a man has after he has been drinking. Since he has been in jail he has felt worried and depressed, but feels nothing which he can call a desire for liquor. Once when he had not been drinking for two months he came to the city on a holiday, and going by a saloon it seemed that he must go in and get a drink. The thought almost made him dizzy, felt as though he could not take any interest in anything, as though all the fun and excitement would be monotonous unless he had a drink to help him enjoy it; but he resisted the temptation, went into a restaurant and had dinner, and all the rest of the day he had no thought of drink. Sometimes when he has a craving for drink other things will satisfy him, as non-alcoholic beverages or a dinner, as in the case described above. The presence or odor of alcohol will not always arouse a craving. He has often been where there was plenty of it, and would have no desire for it, and could not be induced to touch it.

Case 25. Woman, 52. Periodical drinker for the last 17 years. The periods have usually come at intervals of from four to six weeks. She has been six months without drinking. Thinks she has been worse since she was 44. For the last four years and a half she has n't drunk at all, having been in voluntary confinement in an inebriates' home. She is not in any way under restraint. She goes out to church and on errands, and during the day works, serving the establishment in the capacity of cook. In appearance she is strong, well nourished, apparently of strong will, very intelligent. Has a deep religious sense, is extremely sensitive about her degradation and her menial position. Is at times unsocial, irritable and sarcastic. She still has the craving for alcohol, which is likely to come about once in a month. At those times she goes to the matron and asks to be watched. She thinks that she will have to fight this craving all her life. Her only physical ailments, so far as she knows, is slight dyspepsia and nervousness. If things go wrong the craving is likely to be more intense. At these times she feels as if she must hold herself to keep from going out to get a drink. At communion service the taste of unfermented wine makes her "mad" to drink the whole cup. The craving is not a thirst, and it is very different from the craving she used to have after drinking. Then she would tear everything to pieces to get a drink. Would walk from the battery to Harlem for it. Her craving, as nearly as she can analyze it, seems to be a longing made up of depression, increased sensitiveness to slights of all kinds, and a general nervous irritability.

The testimony of all the men who were questioned upon the subject goes to show that the craving for alcohol is a rather unimportant part of the intoxication impulse. As one expressed it, "the craving for alcohol is more than a desire to take a drink, it is the craving for something which accompanies it." With one or two exceptions the testimony is that after a man has been without drink for a few days (10 days is the

time mentioned in most cases), there is no longer a craving for alcohol. This is especially true when a man is so situated that liquor cannot be obtained. This testimony is emphatic, and there is no doubt whatever of its correctness as far as the introspection of the subjects will go. The testimony is equally as emphatic that for the first few days the craving is often intense, that there are physiological accompaniments, such as a general distress, burning in the throat or stomach, weakness and trembling. The usual reply, when a man was asked whether he felt the loss of liquor when it could not be obtained, was, "I never think of it," or "It never bothers me at all." On the other hand, the testimony is equally strong that tobacco is missed. There can be no doubt, whatever, of this difference of feeling. The change of expression of the face when tobacco is mentioned cannot be mistaken. Many say, "I think of it every day." As to the interpretation of these facts, a partial explanation of the difference is to be found in the fact that tobacco is sometimes obtained in jail and is secretly used. The thought that there is a possibility of obtaining it keeps alive the craving. Another reason is the fact that tobacco is not regarded as the cause of the disgrace and annoyance of imprisonment. Another cause, and in all probability the most potent of all, is the social condition of a man in prison. Tobacco is, perhaps, most enjoyably used when a man is alone and inactive. It is a solitary habit quite as often as a social habit, and the solitariness of prison life continually suggests the use of tobacco. The alcohol habit on the other hand is not a solitary habit in most cases. The conditions of prison life are unfavorable for keeping alive the desire for drink, which is in general an accompaniment of the social consciousness. It is certain at least that whatever longing or craving a drunkard in prison may have, it is not recognized by the man himself as a craving for alcohol. The only real conscious craving, so far as can be discovered, is in the neurotic cases. The clearest example of a craving for alcohol is case 25. In this case there is doubtless a nervous disturbance of some kind which is periodic, and which is interpreted as a craving for alcohol. This may be an erroneous judgment on the part of the subject. The strongly fixed belief, that there is indelibly stamped into her organism a craving for alcohol, no doubt tends to keep alive the craving. It is certainly nothing more than association, which makes her "mad" to drink all the unfermented wine at communion.

In other cases the effect of the popular belief in the organic nature of the alcohol habit, instilled into the mind of the drunkard by people who are trying to help him, is evident in making him lose hope, if it does not actually take away the possibility of cure.

Further evidence of the mental nature of the craving for drink is furnished by the cures. The conversion and moral cures are confessedly mental. They cure the craving for drink by changing the general life interest. Leuba[1] gives in detail several cases in which the drink craving was taken away instantly by conversion. From this article the following are quoted:

Man, 42. Converted when 33. Sometimes drunk for a week together. Then not a drop for a whole month. Never went more than a month but once, when he joined the Good Templars, when he went without drink for three months. He experienced sudden conversion. "From that hour," he says, "drink has had no terrors for me, I never touch it, never want it." Another says, "I believe that God took away the appetite for drink that night when I asked him. Man, 44. Converted in 1883. Had been a hard drinker. Made many resolutions, but could not keep them. Had a sudden sense of powerlessness, experienced conversion. Conversion took place on Sunday. "On Monday," he says, "there was no desire for drink." "Since that day I have not had to surmount strong temptations."

Two of my own cases show well the mental nature of the cures for intemperance.

Case 26. Man, 48. First drink at eighteen with a crowd. Became a settled habit at 28. Drank every day. Began on beer, and about 28 changed to heavier drinks. Would go two months drinking everything then stop for a week from physical incapacity to drink anything more. Drank to keep up an exhilaration so that he could do more work. Drank when he hated the taste of liquor, and could hardly get it down. But had to take it in order to appear right. Took more and more as time went on. Before he was 38 had tried to reform several times. Changed his residence, but it did no good. Always drank alone for the reason that he did n't want any one to know about it. Never stayed in a saloon longer than was necessary to get what he came for. When 44 he had been drinking very hard, and his wife made him promise to try to reform, urging him to become converted. He had always scoffed at the idea that change of heart would do it, but went to a clergyman and told him that he would sign the pledge for a year. The clergyman would not accept it, so he made out a life pledge and signed it. Gave his wife all the money he had except a very little, thinking that if nothing could cure him, he would buy some liquor. For a few days, after signing the pledge, he was terribly weak and unable to act. All the time there was a craving for liquor. He knew that it would put new life into him and make him act. The craving was settled in one day. It suddenly occurred to him that he was not more than half honest in the matter, so he went to his wife and gave her the rest of the money and confessed his intentions. As soon as he had done that, it seemed as if the craving was entirely changed and from that time on, until nearly three years after, he had no craving for alcohol. His health was good, worked at the hardest kind of work, chopping in the woods, and, so far as he knows, felt no effect of his hard drinking after the first two weeks. At the end of three years, when on a visit to a summer resort, he drank two glasses of cider. The next day he was as weak as ever. Found out that the weakness had not healed, became frightened, fearing that his drink habit would return, and started

[1] Leuba: A Study in the Psychology of Religious Phenomena. *Am. Jour. of Psychology*, April, '96, Vol. VII, No. 3, pp. 309–383, Appendix.

away in the rain to walk seven miles to the depot. When he reached the first house, he stopped and asked for a drink and got it. Got some more a little further on. This commenced a downfall more complete than the first. He has continued drinking up to the present time. Says that he has to have alcohol to keep him steady, and to make him think. If he goes a day without it, his nerves seem to be shattered. Thought he could n't add a column of figures unless he had his drink in the morning.[1] Has a craving for liquor which he cannot resist.

Case 27. Man, 44. Was through college at 18. Went to work in a bank. At 22 began to drink steadily, brandy and port wine being his favorite drinks. Drank for the taste of the liquor mostly. Belonged to clubs, and drank at socials. Soon began to use liquor to excess, and drank both for the taste and the feeling. It was steady drinking all the time. Drank in company altogether. Later, drank alone but never to get drunk alone. There was hardly a day that he did n't drink excessively, although he never went to extreme intoxication. The last two years of his drinking (from 42 to 44), did n't try much to control his appetite. Kept up his business, and used to do better work after he had three or four drinks. Was doing some literary and lecture work at the time. Always drank heavily before going to make a speech. Stopped drinking in April, 1894. Had been to a kind of a racket at a club, drank heavily all night. In the morning was walking around with three or four men. It suddenly occurred to him that he was living a useless life, told the men he was with that he was not going to drink any more. They laughed at him and told him that he could not stop. Drunk as he was, he sat down and made out an agreement not to drink any more from April 14 to July 4. This he agreed to sign if one of the others would. One agreed, so he signed the paper and handed it to the other man. The other one remarked that as long as he had the agreement, he guessed he would not sign it himself and put it into his pocket. This angered him and he made up his mind to keep the agreement, whether the other man did or not. Did not drink any more that day, left the men at four o'clock and went home sick. Went to a doctor who told him that he would have to stop by degrees, or it would kill him. But he refused to drink. After a week there was no craving and he refused liquor ten times a day for the next six months. He has never drunk since. Very frequently now he goes into a saloon with friends, but always calls for non-alcoholic drinks. The odor and sight of liquor do not arouse in him any craving. He has noticed that since he stopped drinking he cares less for the society of men and feels that in a way his social feeling is weakened.

In other cures the principle is psychic. Most of the inebriates' homes depend upon moral instruction and social environment. The principle of such a cure as the Keeley Cure is largely, if not altogether, mental. In the methods, which are used by regular practitioners, reliance is placed upon general tonics and moral influence. Other cures make use of substitutes which have an effect similar to alcohol. Emetics are given which create an association of nausea with the taste of alcohol.

The evidence from the cases indicate that the craving for drink is not a craving of childhood. In the few cases in which

[1] A series of tests on four consecutive days during which he took no alcohol, disproved this, however. He did better each day, and much better than when he was using alcohol. During his abstinent days he felt no craving for liquor because 'he knew he was not going to have any.'

the first drink was taken at nine or ten the real history of the case does not begin until some years later. In general, if our cases are typical, drinking does not begin during school life. In a great majority of cases the first drink was taken after the boy had left school and had begun to associate with older men. The beginning was almost always social. In but two instances was the first drink taken alone. There are one or two instances in which the first drink was taken after 40. In the latter cases alcohol was taken by a doctor's orders, and the habit thus formed was never broken. Below is given a table showing the age at which the first glass was taken in 65 cases.

Table showing when first drink was taken in 65 cases.

AGE.	NO. OF CASES.	AGE.	NO. OF CASES.	AGE.	NO. OF CASES.
9	1	20	6	31	0
10	1	21	1	32	0
11	1	22	5	33	0
12	2	23	0	34	1
13	0	24	1	35	1
14	5	25	3	36	0
15	6	26	2	37	0
16	10	27	2	38	0
17	8	28	0	39	1
18	5	29	0	40	1
19	1	30	1		

Below are tabulated 498 cases[1] of inebriety with reference to the time when the drinking habit was formed. This does not refer to the time when the first drink was taken, but when more or less regular drinking began.

By referring to the tables it will be noticed that among the 65 cases more took the first drink at 16 than at any other year. At 20 is the greatest tendency for drinking to become a habit.

Parrish[2] says that the drink craving does not declare itself until the demands upon the nervous system come to be exorbitant, and that its terminal period comes with as much certainty as does its initial stage. He thinks 'that there is an inebriate climacteric in every life, when nervous periodicities become faint, when internal and external excitants to intoxication lose much

[1] These cases are from statistics taken from Thomann's Real and Imaginary Effects of Intemperance.

[2] Alcohol Inebriety, 1883.

Table showing age at which drinking was commenced in 498 cases.

Age.	No. of Cases.		Age.	No. of Cases.		Age.	No. of Cases.		Age.	No. of Cases.	
	Males.	Fem.		Males.	Fem.		Males.	Fem.		Males.	Fem.
10	2	0	22	32	2	33	10	5	43	1	1
11	0	0	23	21	1	34	8	4	44	2	2
12	4	0	24	22	0	35	9	2	45	2	0
13	6	0	25	17	4	36	3	2	46	1	1
14	8	0	26	14	3	37	2	2	47	1	0
15	26	0	27	16	2	38	2	0	48	2	0
16	14	2	28	13	3	39	1	4	49	5	1
17	19	0	29	8	1	40	3	0	50	3	0
18	35	1	30	20	5	41	1	0	51	1	0
19	18	2	31	4	0	42	2	1	52	1	0
20	50	3	32	3	1				53	0	0
21	29	0							54	2	0

of their vigor, and the inebriate diathesis is too feeble to respond to excitation. Between forty and fifty a great number of spontaneous recoveries occur. Between fifteen and twenty-five most cases begin. About twenty-five years closes the drinking period, either by exhaustion of the desire, or by death.' Crothers[1] says 'that there are periods from seventeen to twenty-five and from thirty to forty in which the liability to contract the drink habit is greatest. This is most likely to die out between forty-five and fifty, or from fifty-eight to sixty-two. The physiological changes of mature life bring changes of nerve vigor and growth, periods closely corresponding to the evolutionary periods of women.' Superintendent Hadley, of the McCauley Mission in New York City, says that most conversions of drunkards take place between the ages of thirty and fifty. Dr. Braintwaite,[2] Superintendent of the Dalrymple Home in England, says that most of the cures take place between thirty and forty-five, though many cases do well older, up to fifty-five and sixty. The younger cases are most unsatisfactory. He says "very few, indeed, succeed in getting right under twenty-five or twenty-six." If the physiological basis of the drink craving is the change of protoplasm, due to the continued assaults of alcohol, as many maintain, it would be difficult to account for the fact that young men are, as a rule, less easily cured than older men.

From the data obtained from these cases we can simply enumerate the usual motives which lead to intoxication. For a quantitative estimation of these motives a much greater number of cases would be needed. They are as follows: (1) a desire for excitement, experience and abandon; to increase companionship, to put off reserve in the presence of others. (This desire to heighten the social feeling is probably the most prominent cause

[1] In correspondence.
[2] In correspondence.

of drinking. Many drunkards would regard it as a disgrace to drink in any other way than socially.) (2) To kill pain, to calm moral distress, to overcome fatigue, a desire for temporary relief from poverty or monotony; to increase courage or overcome self-consciousness, to steady the nerves for work or unusual strain.

Thus far we have found evidence to lead to the conclusion that the craving for alcohol, as felt by the drunkard, is not a specific craving, and that when the occasion of drinking is removed usually nothing remains of the craving as such, or it is so merged in other desires that it is not recognized by the subject. A drunkard is what he is because he enjoys a certain mental state, which is most conveniently induced by alcohol. This mental state is very closely associated with the social impulse. The moderate drinker, who never drinks to intoxication, belongs to quite a different class. He drinks, for the most part, because he likes the taste of alcoholic beverages.

§ 5. Effect of Intoxication upon the Literature and Language.

Intoxication, like all peculiar and abnormal mental states, is a subject of natural interest to primitive people, as is shown by the influence it has exerted upon the language and literature. In fairy tales intoxicants are often spoken of. The love potions and philters, elixirs and waters of life are often stimulants and narcotics, as well as aphrodisiacs. Of the gods of wine Dionysus of the Greeks and Indra of the Hindus are best known. Drunkenness was also honored by divinities among the ancient Mexicans.

Among primitive peoples the common element in the myths of wine is the belief in its divine origin. Intoxicants are believed to lift the soul up to a higher level, to bring it into touch with divine powers. Wine is often included among the pleasures of the next world.

The remarkable influence that intoxication has had upon the popular mind[1] is shown by the great number of synonyms for the state which have been in common use. No other thing except the sexual relationship has made a deeper impression upon the popular language. Below are given a few synonyms collected from the slang literature and other sources. No attempt was made to make the list even approximately complete. Some purely local expressions are included. Translations from German and French have been omitted.

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[1] Ribot, quoting from Renan says, "a people have usually many words for what most interests them." (Evolution of General Ideas, p. 76.)

Most of these terms are expressions of contempt, having reference to the disabled stage of intoxication. A few, like inspired, electrified, jolly, glorious, exalted, refer to the stimulated stage.

Synonyms for Intoxication. A bit on, addled, off, all key holes, all mops and brooms, all sails set, a passenger in the Cape Ann stage, artificial, at rest.

Bacchi plenus, back teeth afloat, bamboozled, banged up to the eyes, battered, beastly, been among the Philistines, been at a ploughing match, been flying high, been hit by a barn mouse, been lapping the gutter, been in the sun, been rushing the growler, been sucking the can, been taking bitters, been taking tea, beery, bended, bitch fou', blowed, blind drunk, blowing, blued, blue eyed, boiling drunk, borey-eyed, boosey, breezy, brick in the hat, bright in the eye, bruised, budgy, buffy, bummy.

Canonized, can't say "National intelligence," can't see a hole in a ladder, caught a fox, caught favor, channels under, chirping merry, chuck full, clear, clinched, cocked, come from Liquor pond street, comfortable, concerned, corned, cosey, coxy-loxy, croaked, cronk, crooked, crook-in-the-elbow, crying drunk, cup-shot, cut.

Damaged, dazed, dead drunk, dipped deep, discouraged, disguised, done over, doped, down in the mouth, down with the barrel fever, drowning the shamrock, drunk, drunk and disorderly, drunk and dressed up, drunk as an ass, drunk as a biled owl, drunk as a brewer's horse, drunk as a drum, drunk as a fiddler, drunk as a fish, drunk as a fly, drunk as a Gassport fiddler, drunk as a lord, drunk as a mouse, drunk as an owl, drunk as a pipey, drunk as a tapster, drunk as a rat, drunk as a sow, drunk as a wheelbarrow, drunk as Bacchus, drunk as Chloe, drunk as he can hang together, dry, dull in the eye.

Edge on, electrified, elevated, exalted.

Faint, far gone, feeler on, feels good, feels his oats, feels right royal, feverish, filled to the brim, flag of defiance out, flatch kennurd, flawed, fluffy, flummoxed, flush, flushed, flustered, flusticated, fly blown, flying high, fogged, fogmatic, forward, fou', four sheets to the wind, fow, foxed, fresh, fuddled, full, full cocked, full of ballast, full of pots, full of rum, full to the brim, full to the bung, fuzed, fuzzy.

Gilded, gilded o'er, gilt edge on, glorious, google eyed, got a big head, got a bundle, got a drop in the eye, got a smile on, got the gravel rash, greetin fou', groatable, groggy, gutter legged, guzzled.

Had an eye opener, half and half, half cut, half on, half shot, happy, hard up, hasn't got his sea legs, hazy, headed for port, head light on, head on, heady, hearty, helpless, high, high lonesome, hilarious, holds up the lamp post, hoodman, hot, how came ye so, how fare ye.

In a difficulty, in a very good humor, in his altitudes, in good fettle, in good spirits, in his cups, in liquor, inspired, in the blues, in the gutter, in the wind, intoxicated, irrigated, iskimmish.

Jagged up, jag on, jammed, jib well bowsed, jim jams (has the), jolly, joyful, jug-steamed.

Kisky.

Laid away, leary, leery, legs broke, limber, loaded, loaded for bears, loaded to the gunwales, load on, looking lively, loose, lumpy, lushed, lushy.

Main brace well spliced, making m's and w's, martin drunk, mawled, medza-beargeared, mellow, miraculous, moony, moppy, mortal, muddled, muggy.

Nazie, night cap on, not in a fit state for discussion.

Obfusticated, off his nut, on a blow out, on a bust, on a hurrah, on

a skate, on a spree, on a tear, on a triumphant, on his fourth, on the batter, on the beam end, on the beer, on the bend, on the fuddle, on the gay galoot, on the lee lurch, on the loose, on the muddle, on the nipple, on the rampage, on the ran-tan, on the re-raw, on the skyte, on the stuff, on the tiles, one sheet in the wind, ossified, out of funds, overcome, overstocked, over the bay.

Paralyzed, peckish, petrified, pickled, pificated, piper fou', ploughed, podgy, pretty well entered, primed, pruned, pushed.

Queered, quaffed the bowl.

Raddled, rather touched, razzle-dazzle, reeling, right, Romeo, roaring, roaring drunk, roaring fou', rococo, rotten drunk.

Salted down, salubrious, sawed, scammered, screwed, sees two moons, set up, sewed up, shaking a cloth in the wind, shaky, shaved, shocked, shot, shot in the neck, skaty, skate on, sleepy, slewed, smashed, smeekit, smelling of the cork, smoled, snakes in his boots, snubbed, snuffy, soaked, society slant on, soft, spiff, spiffed, spoon drunk, spoony drunk, spreeish, sprung, squiffed, staggering full, starchy, stewed, stimulated, striped, stropolus, stuffed, sun in the eyes, swiped, swipey.

Taking it easy, tangle legged, tanked up, tavered, thirsty, three sheets in the wind, tight, tight as a brick, tipsy, tired, tired feeling (has), titley, too much fire water, took a snort, top heavy, touched, turkey on his back, twisted, two sheets in the wind.

Unco', under the weather, under the influence, unsteady, up a tree.

Walks on a bias, water logged, waving a flag of defiance, weak-jointed, weary, well under way, wet, whipped, whittled, winey, wobbly.

Yappy, yaupish.

Intoxication as it appears both in poetry and prose furnishes a field for psychological study. The deepest motives for intoxication are expressed here. Of these there are two which run through all the literature. One is the glorification of pleasure and abandon, the other is the desire to escape from pain. The best example of the first is found in the Greek dithyrambic poetry.[1] A spirit of abandon, love of exaggeration and excess, extravagance of language appear everywhere in the literature of drink. Such verses as the following show this spirit:

> "When I am dead with wine my body lave,
> For obit chant a bacchanalian stave."
> —*Omar Khayyám.*

> "The dry and dusty earth drinks,
> The trees too drink her moisture;
> The sea doth drink the rivers,
> The sun doth drink the sea waves,
> The moon doth drink the sunbeams,
> Why cavil then at me, friend,
> That I am fond of drinking?"—*Anacreon.*

In the college song books drinking is the most common theme, excepting, perhaps, love. Here the spirit is for the most part, like that of the Greek dithyramb, one of jovial excitement; but

[1] See § 2.

there is not wanting a shallow pessimism. The praises of drink as a cure for care and trouble are frequently sung. In Heilbrom's "Carmina Clericorum" fifteen of the thirty-one songs are praises of drink.

But there is much of the spirit of deep pessimism running through this literature. Omar Khayyám, to take a single example, expresses well the narcotic motive in intoxication. Fitzgerald[1] criticises those who interpret the quatrains of Khayyám as symbolic, clothing the deity under the figure of wine, as did Hafiz and other Sufi poets, saying that Khayyám is just what he seems, a material epicurean. There is a fine thread of pessimism running through all his poetry. He frequently refers to the wheel of heaven and the world's injustice. He hates the hypocrisy of the pious, and bitterly charges the sins of men to the account of the Creator. For him wine was a means of relief from trouble.

> "Endure this world," he says, "without my wine, I cannot
> Drag on life's load without my cup, I cannot."

And again.

> "Life is a poison rank, and antidote save
> Grape juice there is none."

Khayyám speaks frequently of his sin. It was quite evident that he was a drunkard, for he says:

> "I am a slave of that sweet moment when
> They say take one more goblet and I cannot."

And, as in the case of many other drunkards, wine dimmed for him other pleasures.

He expresses in verse what many drunkards say when he cries—

> "They preach how sweet these Houri brides will be,
> But I say wine is sweeter, taste and see!"

Much might be added to the account of the influence of intoxication upon literature. Its interest is, however, rather for the psychology of literature and language than for the psychology of intoxication. But one must certainly be impressed with the very great influence intoxication has had, especially upon religious belief, and upon imagination and its expression in language.

The doctrine of stimulus. The doctrine of stimulus in the history of medicine is very closely connected with intoxication. The dualistic philosophies coming from Plato and Aristotle, which placed the soul and life in contradistinction, and even in opposition to body and matter, were absorbed into the theory of medicine at an early date. Life was regarded as an entity or principle which opposed or controlled the body. In order to

[1] The Quatrains of Omar Khayyám (Introduction).

cure disease this vital principle must be spurred on to increased effort. · Hence the disproportionate use in medicine of drugs which affect the brain and thus change the mental condition, and the slow adoption of drugs which, because they affect organs not connected with consciousness, act in a less noticeable manner.

A long list of early physicians including Galen, Paracelsus, van Helmont and Hoffman, held doctrines similar to each other, in that they assumed a life principle which presided over the development of the body, and which needed stimulation in order to overcome disease. The modern doctrine of stimulation (an excitement of normal functions) is obtained by transferring this hypothesis from the life principle to the tissues of the body itself.[1]

§ 6. Analogues of the Intoxication Impulse.

There are many facts which show that there is a normal love or craving for certain states of consciousness, the common element in which is intensity. Examples of such are the love of mental excitement and high emotional states common among children, religious ecstasy and excitement, second breath (mental and physical),[2] dances, violent games involving both mental and muscular activity, social excitement. Psychologically considered these states are very similar to each other, and a study of them leads to the conclusion that intoxication is one form of expression of a more general impulse which is deep-seated in consciousness and very far-reaching in its effects.

States analogous to intoxication appear in animals, in some species of which states of exaltation are habitual. They are, apparently, more common in birds, but occur also among mammals. One or two accounts of these serve to illustrate this phenomenon which appears in all degrees of intensity from a slight increase in activity to orgiastic performances of the wildest kind.

Besides the various plays of animals, in which there appears to be a love of excitement for its own sake, there are other rhythmically occurring periods of intense excitement. Chapman[3] describes the sky dance of the woodcock as a succession of wild rushes in the air, with always increasing speed and with louder and louder cries, the object of which seems to be to rise to the highest pitch of excitement.

Worth describes a dance of prairie chickens or sharp tailed grouse.

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[1] For a full account see Anstie: Stimulants and Narcotics.

[2] Partridge: Second Breath. *Ped. Sem.*, Vol. IV, p. 375, *seq.*

[3] This and the following descriptions are from Morgan: Habit and Instinct.

The birds, in companies of from six to twenty individuals assemble on some hillock or knoll fifty to a hundred feet across, the floor being worn and beaten smooth by years of tramping. After remaining for a time inactive, one of the cocks lowers his head, spreads out his wings nearly horizontally, and his tail perpendicularly, distends his air sacs and erects his feathers, then rushes across the floor, taking the shortest of steps but stamping his feet so hard and so rapidly that the sound is like that of a kettle drum, and at the same time he utters a kind of bubbling crow which seems to rise from his air sacs, beats the air with his wings and vibrates the air with his tail, so that he produces a loud rustling noise and thus becomes a really astonishing spectacle. Soon after he commences, all the cocks join in rattling, stamping, drumming, crowing and dancing furiously; louder and louder the noise, faster and faster the dance becomes, until at last they madly whirl about, leaping over each other in their excitement.

Hudson in "Music and Dancing in Nature," speaks of the screaming contests of Platan rails, and remarks upon the striking resemblance to the human voice exerted to its utmost pitch and expressive of extreme terror and despair. Wallace says: "We see that the inferior animals, when the conditions of life are favorable, are subject to periodical fits of gladness affecting them powerfully and standing out in vivid contrast to their ordinary temper. Birds are more subject to this universal joyous instinct than mammals, and there are times when some species are overflowing with it."

Groos also speaks of the above mentioned characteristic of animal love dances and play, and explains the intense excitement on the ground that it is necessary that the sexual impulse should have tremendous power, and its discharge be rendered difficult; hence the great and long-continued excitement preceding the act of pairing.

Many examples of a similar love of excitement occurring in the human subject, especially at times of accelerated development might be described. At the adolescent period, when impulses to new lines of action have developed more rapidly than self-control, intense sensation, strong emotional excitement, and even immorality often have a peculiar charm, even for normal people. Monotony, routine, and detail are unendurable. Particularly in the social and collective life is this spirit of sensationalism shown. The queer freaks and the breakings-out and the excesses of college students illustrate both the intensity and the imaginative fertility of this craving. Lancaster[1] speaks of the sudden and inexplicable rebellion against authority which appears in the first years of adolescence.

Primitive peoples also show an intense love of excitement in almost every social event of their lives. A culmination in intense excitement is very frequent, in fact a customary and natural

[1] Psychology and Pedagogy of Adolescence. *Pedagogical Seminary*, July, 1897, p. 85.

termination of all gatherings of uncivilized man, whether for religious or for social purposes. The various shaman cults are as good an example of this tendency as any. A festival lasting a number of days usually has a culminating day or period, or it may end in a wild dance or in general intoxication. A moderate height of excitement maintained for a considerable period of time seems to be unnatural to primitive man. Dancing, especially when, as so often occurs, it is accompanied by intoxication, affords an excellent example of the tendency. A few illustrations will bring out more clearly this characteristic of the mind, which is not confined to any single function of the social or religious life, but is found everywhere,—at marriages, funerals, games and simple social gatherings. But more particularly the public festivals and dances are occasions of throwing off of all control and giving the mind over to the intoxication of movement, of sexual excitement, and general abandonment. Intoxicants may or may not be used to induce these intense states. Pain, scourging, games of torture, fasting, fantastic sights, and hideous sounds, as well as violent movements all serve the same purpose. Public festivals which begin with much dignity often degenerate into scenes of wild disorder before they are finished. The great war dance of the Tupis is an illustration.

> They arranged themselves in groups, and at a well known signal each group began to sing, at first in a low tone of voice, which became louder and terminated in dreadful yells and hideous howls. The jumping was so violent and their efforts were so furious that some of them fell senseless to the ground. Three or four payes or sorcerers stood in the center, shook the tamarak, and blew tobacco smoke from a cane pipe upon the dancers.[1]

Mrs. French-Sheldon[2] says, speaking of some of the customs of the natives of East Africa.

> "The young fellows will collect in groups and dance as though in competition; they dance with their knees rigid, jumping into the air until their excitement becomes very great and their energy almost spasmodic, leaving the ground frequently three feet as they jump into the air. At some of their festivals this dancing is carried to such an extent that I have seen a young fellow's muscles quiver from head to foot, and his jaws tremble without any apparent ability on his part to control them, until, foaming at the mouth and his eyes rolling, he falls in a paroxysm upon the ground to be carried off by his companions. This method of seeking artificial physical excitement bears a singular resemblance to the dances of other nations outside of Africa."

Examples of this tendency might be multiplied to any extent. The reader is referred to the literature of plays and games and dancing.

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[1] Featherman: *op. cit.*, Vol. III, p. 341.

[2] Customs among the Natives of East Africa. *Jour. Anthropological Inst.*, 1891, p. 367.

Certain historic periods seem to have been characterized by a love of excitement. This is well shown by the Dionysiac cults in Greece.[1] It also occurred, in a remarkable degree just before the intellectual awakening at the time of the Renaissance, especially in Italy. All students of the period seem to agree that it was a time of extreme sensuality, accompanied by a love of display and dramatic effect. It was a time of great church feasts, and great civic processions. The carnivals in Venice, in particular (1459), were famous for their great torch-light processions.[2]

Other changes in the national consciousness accompanied this craving for new and strong sensations. Burckhardt[3] says: "In the Middle Ages man was conscious of himself only as a member of a race, people, party, or corporation, but now the subjective side asserted itself and man became a spiritual individual and felt himself as such. Adams[4] says that the Renaissance was more than a revival of learning. It was a revival of emotions also, an awakening of man to a new consciousness of himself and of the world. The work of the Renaissance was to awaken in man a consciousness of his powers and to give him a confidence in himself. It was a craving for freedom which more than anything else characterized the times. There was a change from outer to inner control and the result was a time in which there was no control at all. Hence the great vices of the period. Burckhardt[5] sums up the character of this age by saying: "The fundamental vice of this character was at the same time a condition of its greatness, namely, an excessive individualism. This immorality was a historical necessity; with it has grown up a modern standard of good and evil." He apologizes for the immorality of that day by saying that it was not of low order. Symonds[6] also takes this ground in explaining the illicit loves of this time, saying that they were not merely sensual, but were due in great measure to the demand for imaginative excitement in all matters of the sense.

A striking sex difference appears in all these activities, not only as they occur among animals, but also in the human subject. Ellis[7] says that among primitive peoples the occupations which require intense activity alternating with long periods of apathy are chosen by the male. The monotonous work falls to

[1] See § 2.
[2] For a full account of this period see Burckhardt: The Civilization of the Period of the Renaissance, and Symonds' Renaissance in Italy.
[3] *Op. cit.*, Vol. I, p. 181.
[4] Civilization during the Middle Ages, p. 365.
[5] *Op. cit.*, Vol. II, p. 246-7.
[6] *Op. cit.*, Vol. I, p. 411.
[7] Man and Woman, p. 2.

the lot of the women. It is true also of intoxication, that it occurs far more frequently among men than among women.

A consideration of other secondary sexual differences between male and female shows a similar tendency. Geddes and Thomson[1] speak of the more active physiological habit of the male. His activity is more katabolic; he lives at a greater loss; the physiological habit of the female is more anabolic. Taking all the above described phenomena into account, the most probable explanation is that they are expressions of a general instinctive tendency, and that it has been preserved because it has favored mental development. Granted the existence of an instinctive impulse to seek intense states of consciousness, its preservation can easily be accounted for. (1) It is a direct accompaniment of a healthy and vigorous state of the organism. (2) Intense excitement may have been of service in connection with the regulation of the sexual impulse (Groos). (3) It also serves in the individual as a propædeutic to higher forms of emotional and mental activity. (4) The forms of activity resulting from this impulse have had a very great social value. (5) They have also by favoring activity led to a natural experimentation which has assisted adaptation (Morgan).

At the present time the ability to endure long continued mental activity at a high degree of tension is one of the essential qualities which favor success. For a life of mental activity the excitement and love of strong sensations at the time of adolescence is natural training. There is no reason to believe, therefore, that this impulse will decrease, but rather on the contrary that it will increase, favoring a greater capacity for intense states of consciousness. Directly in line with the conclusion that the forms of activity mentioned above are expressions of a general instinctive tendency is the theory of play as held by Groos. The conclusive argument against the overflow theory of play, as held by Spencer, applies directly to the forms of activity under discussion here, and favors the conclusion that the impulse to seek intense states of consciousness is not an expression merely of a high state of nutrition, but a true instinctive tendency which has grown up as a necessary aid to mental development. Like all other forms of instinctive activity, it may be exceedingly active even in organisms in which a low state of nutrition causes it to be a source of peril, or even destruction.

Doubtless there are conditions of nervous exhaustion in which the craving for excitement becomes abnormal in degree. The sensuality of the decadent days of great nations may be explained as an expression of exhaustion. In the sensuality which followed the Napoleonic wars in France there is a good example of the effect of overstrain and fatigue in causing

[1] The Evolution of Sex. pp. 18, 270.

a craving for excitement and for new sensations. This impulse found expression in the literature of the time, perhaps most characteristically in Huysmans, the novelist.[1]

§ 7. Résumé and Criticism of Theories of the Intoxication Impulse.

In the following section abstracts are given of various theories of the intoxication impulse and the craving for alcohol. Some of these theories are uncritical, but taken in connection with others they show tendencies of thought.

A prevalent opinion about the alcohol craving, one which makes up the philosophy of many who advocate temperance, is that intoxication is a form of sin, and needs little explanation. Another view which explains nothing is that the craving for alcohol is a diseased appetite.

Baer[2] thinks that the craving for alcohol is not an instinctive but an acquired craving.

Gustafson[3] says that the desire for alcohol is a habit becoming instinctive and a form of depraved second nature.

Nordau[4] says that the craving for alcohol is a craving for relief from pain and an expression of a need for stimulation, there being a general condition of neurasthenia, especially noticeable in the upper classes of society and due to the fatigue caused by the sudden incoming of machinery, rapid transit, and exciting occupations. Lett[5] asks "Why do men drink?" and gives about the same answer as Nordau. "Because there is pain. The healthy man has no pain and needs no stimulant. One kind of pain, unrest, is the outcome of an unstable nervous organism. Disquietude, unrest, pain are the causes of drinking."

In an anonymous article in the *University Magazine*, entitled "The Philosophy of Stimulants," a writer expresses the view that stimulants and narcotics are used because they intensify consciousness; they make wider variations in life; our pleasures and pains are too evenly distributed, and it is a matter of instinct with us that we try to summate them.

Moxon[6] says that alcohol weakens common sense in its opposition to individual sense. The power of alcohol in the world is that it keeps down the oppressive power of others and their common sense over the individual sense. Alcohol raises a man's

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[1] Leuba: National Destruction and Construction in France as seen in Modern Literature and in the Neo-Christian Movement. *Am. Jour. Psychology*, July, 1893, Vol. V, No. 4, p. 498.

[2] Der Alkoholismus; also Die Trunksucht und ihre Abwehr.

[3] The Foundation of Death.

[4] Degeneration.

[5] The theories of Lett, Monin, Hughes, Day, Danielewski and Forel are to be found in scattered articles in the *Journal of Inebriety*.

[6] *Popular Science Monthly*, 1879, Supplement, N. S. I, p. 30.

individuality temporarily. It reduces the common sense relations between men.

Thomann[1] says that the desire for alcoholic beverages is generally a physical desire, an animal lust.

Monin says that in proportion as civilization perfects itself man seeks in drunkenness a compensation for, and a forgetfulness of, the weariness and chagrin which result from his daily struggle for existence.

The supposition of all those who believe in a specific for the craving for alcohol is that it is a physical appetite which can be destroyed by the use of drugs. A statement of the views of a single one of these will be sufficient to illustrate these medical theories. He has two specific remedies, one to remove the neurasthenic condition which he says is present in all cases of inebriety, and another to remove the craving for alcohol. With these he claims to cure men of all ages in any stage of the disease, and to establish such a normal condition of body and mind that although they may drink again they will never drink again from necessity, or because they are victims of an appetite, but only from choice. He maintains that the craving for alcohol and the desire for stimulants in general, such as hasheesh, morphine, and chloral, are expressions of one disease; they all have their roots in a neurasthenic condition. Other cravings, such as a passion for strong electrical stimulation, are of the same nature, the expression of a lowered nervous tone and a desire for something which will create activity in inactive organs.

The advertisements of specifics which can be administered to a drunkard without his knowledge and cure his desire for alcohol, also illustrate this pseudo-medical and popular view that drunkenness is caused by a diseased craving.

Hughes says that the drink craving is a pathological perversion of physiological cell action, and lies in the realm of the cerebral cortex.

"That there is an organic appetite for brain stimulants which, if not originally so, has become organic through unknown ages of indulgence common to man," says Day, "is beyond dispute. This appetite does not anticipate for its gratification more than the primary or stimulating effects of the drugs used. It is through this appetite that the system is often exposed to an unexpected and undesired effect of the drug and a painful condition of the body induced by such unintentional excess, which can in no other way be so speedily and effectually relieved temporarily as by the repetition of the excess itself, by renewed

[1] *Op. cit.*

stimulation of the organs suffering, or in an obliteration of sense by a more complete narcosis than was at first intended."

Braintwaite[1] says that drunkards are made by the effect of alcohol upon unformed and developing tissue, especially cerebral tissue.

Danielewski says that civilized man has used alcohol so extensively, and for so long a time, that one may with certainty affirm the existence of an alcoholized protoplasm in drunkards just as one finds morphinized protoplasm in cases of chronic intoxication with morphine. The organism can no longer do without it. Hence it follows that the complex of protoplasm and albuminoids is adaptable; that it is not incapable of being disturbed in its fundamental properties; and that it is reconstructed with difficulty.

These notes will serve to show some general tendencies of opinion in regard to the nature of the intoxication impulse.

In the views mentioned thus far no attempt is made to explain the development of the craving for stimulants, except by the hypothesis that it is a result of generations of indulgence; in other words that it is an acquired habit which is becoming a so-called secondary instinct.

Forel has also expressed a similar view in an article in which he speaks of the future of the alcohol craving in the race. "We do not think," he says, "that man could ever adapt himself to the use of alcohol and narcotics, so that they would cease to hurt him, for the following reasons. Experience teaches, (1) the general drinking and narcotic customs incessantly augment the production and the consumption, that is, increase the daily doses which every man consumes in the average. (2) The craving which alcohol and all other narcotics produce drives to such augmentation with peculiar force where severe laws do not counteract. (3) Alcohol, and probably also all other narcotics, poison not only the individual, but also his sperm, the germs of his descendants. (4) The progeny of alcoholists, according to experience, are especially exposed to mental degeneration and to drinking excesses. Their resistibility against alcoholic liquors is never raised, rather very much diminished."

Beard[2] asks the question, "Why does man, so much higher than the animals in every respect, alone possess the vice of intemperance?" "What makes us to differ from them?" and answers, "Mainly our nervous system." Man has a larger, fuller, richer brain than the lower animals; and stimulants and narcotics chiefly affect the brain; therefore man craves for them, finds rest and negative food and pleasure in them, and thus

[1] In correspondence.
[2] Stimulants and Narcotics.

often becomes their slave. The horse does not care for alcohol, for the same reason that it does not care for philosophy, because its brain is not capable of appreciating it."

He says: "The most enlightened nations of our time are Great Britain, Germany and the United States, and in these countries stimulants are used in the greatest abundance and widest variety. Next to these nations in order of enlightenment and in order of indulgence in these substances are France, Russia, Norway, Sweden, Italy and Spain. The semi-civilized nations, as Turkey, Syria, India, China, Japan, South America and Mexico, use some varieties to considerable excess, but have not so many varieties, and do not, on the whole, use as great a quantity of stimulants and narcotics as the nations who are at the head of civilization. The purely barbarous races and tribes use at most but one or two varieties, and, as a rule, to but little excess. Africa seems to have used less than any other continent.

"In civilization the expenditure of force is vastly greater than in barbarism, because the brain, especially, is more active. To compensate for this expenditure, to retard the waste of tissue, or at least to sustain the body amid the cares, toils, and pressure incident to advanced civilization, men resort, not only to a more liberal and abundant variety of food than the savages use, but also most employ a wider range of stimulants and narcotics. It would seem that the use of stimulants and narcotics in general has increased with the advance of the race. In general, also, the higher civilized races use stronger liquors and more abundantly, and since in the lower races there is less moral and other restraint, we must conclude that they are not tempted to drink to excess, that they do not enjoy the exciting effects of the stimulants, as do the northerners. There is ten times as much intoxication in Great Britain and the United States as there is in Germany and France. There is far more of the grosser type of intemperance in the northern than in the southern climates. This difference is due primarily, probably, to difference in environment, climate, etc., and only secondarily to difference in race. The English, the Germans and the Americans are of all people the most energetic. Associated with this courage and vigor is a powerful development of some of the lower passions. They are fond of eating and drinking, and although less licentious, less artful than the French, Italian and Spanish, they are more addicted to coarse and brutal crimes. Coarse crimes and drunkenness are twigs growing on the same stem.

"Drunkenness and the amount of liquor consumed in a given country are independent variables. England uses more alcohol, in various forms, than America, but it has less drunkenness. In France the consumption of liquor is very great, but the French are by no means a grossly intemperate people. The explanation of this paradox is that national intemperance does not result so much from widely diffused habits of drinking as from great excess among a limited number. The poor and ignorant classes among civilized nations are most given to intoxication. They are brought into the presence of the same variety of stimulants as the higher classes, and they have less moral control. Woman, everywhere, uses less intoxicants than man, not so much because her moral force is greater, but because she has less desire for the effects of stimulation."

Beard makes much of the effect of climate in determining the difference of drinking habits in different nations. The effect of climate is to produce types of organization — the effect being shown also in psychic traits. He says "Protestant Christianity is the religion of a liberty-loving alcohol-loving people, who have a strong passion for

independence and for sensual indulgence in its most active and violent forms."

The most important of the recent views in regard to the intoxication impulse is that held by Reid. Of this a detailed account is given here for the reason that it is believed by the present writer not only theoretically wrong, but also to involve a very grave pedagogical error.

Reid is led, after a general survey of the present evolution of man,[1] to the following three conclusions: (1) That every species must necessarily undergo retrogression unless that retrogression be checked by selection. (2) That in such a high multicellular organism as man acquired variations cannot be transmitted. (3) That in such an organism, living amidst immensely complex and heterogeneous surroundings, the action of natural selection has been mainly to develop so extraordinary a power of varying in response to appropriate stimulation, direct or indirect, from the environment, such a remarkable power of individually acquiring fit variations that very much, indeed by far the greater part of the characteristics of such an organism are due to stimulation acting upon this power to vary, are variations acquired by the individual, but variations which are not transmissible. At present man's most formidable enemy is the immensely numerous class of animal and vegetable disease germs which continually threaten the safety of the race, and by ceaseless selection weed out the unfit. Moreover, immunity to one disease germ does not afford immunity to another, and each which comes into contact with man, so as to cause the destruction of a sufficient number of lives, is the object of a special process of evolution.

"On the mental side we find," says Reid, "numerous habitually used drugs and poisons which act with sufficient violence and to the harm of sufficiently large numbers of the race to be the objects of special processes of selection. The chief of these poisons is alcohol. In generation after generation alcohol is the cause of the elimination of a considerable number of the unfit in relation to it, and is the cause of considerable evolution against itself. This evolution may be in one or both of two directions, increasing power of tolerating the poison or increasing power of avoiding it, an increasing power of imbibing alcohol without ill effects, or the diminution of the craving for it, or both. But as increasing immunity to the poison means only imbibing larger and larger quantities, evolution must be in the direction of a decreasing craving for it. This is what we should expect, *a priori*, and this is what we do find. Races which have been long familiar with alcohol, like races long familiar with a prevalent and deadly poison, are less harmfully affected by it than races which have had little or no experience with it, and this because they crave less for it and drink less of it. The peoples of the Mediterranean, the Greeks, the Italians, the southern Frenchman and the Spaniard, who have lived for thousands of years in the presence of an abundant supply of alcohol are preeminently temperate. The natives of North and South America, Australia, Polynesia, Africa, Greenland, whether in Arctic, Temperate or Torrid zone, crave for it so much that they perish in its presence, unless we protect them with prohibitory laws. Races which lie between these extremes in regard to experience with alcohol, as the people of northern Europe, the English for example, are also between them in regard to the resistance to it."

[1] The Present Evolution of Man.

The question as to how the craving for alcohol and other narcotics, the love for those states of mind which they severally induce, arose can be answered in only one way. It can have arisen only as a by-product of mental evolution, a by-product which, in the absence of narcotics was harmless, but which in the presence of them is harmful, and against which, in races long affected by this or that narcotic, a secondary evolution has occurred. This craving, according to Mr. Reid, is a specific craving. Nothing else but alcohol satisfies it. It is not transferable, so to speak, and evolution against other drugs does not affect it.

Reid insists that traits acquired under the influence of alcohol are not transmissible any more than other acquired traits are. To quote, "The craving for alcohol depends upon consciousness, which, in turn, depends upon the presence of nervous structure. That the germ is bathed in alcohol cannot account for the habit being developed in the child."

Racial differences in regard to immunity against alcohol craving are not due to the fact that some races are by nature abstemious, nor is it due to differences in education. The craving for alcohol is an instinct and not an acquired trait. It is comparable to hunger and thirst, or to sexual and parental love; not to a love of books or of paintings, or of country, or of a particular religious system. To quote again, "It is conceivable that a man might be reared in entire ignorance of women, but in such a case, though he knew not what he desired, he would yet crave for them, and his passive desires would instantly be stimulated into activity by their presence. So a savage of a race not rendered resistant by alcoholic selection craves unknowingly for alcohol, for that state of mind which alcohol induces. Racial difference is not due in any degree, as has been maintained, to difference in the strength of alcoholic beverages in use in the different countries. On the contrary, the strength of the craving determines the degree of concentration of the alcoholic beverages."

The degree of intoxication desired by the average individual of any race, when once that desire has been awakened in him by alcohol, is exactly in inverse proportion to the past familiarity of the race with the poison; in other words, it is exactly in inverse proportion to the amount of elimination alcohol has caused in the ancestry. The smallest amount of alcohol produces some mental change. The instinct is never entirely eliminated in any race. The differences in the races lie in the degree of intoxication desired. To quote from Reid once more what seems a very curious piece of reasoning. "The direction of the process has been toward a lesser craving from a greater craving, and in some cases, *e. g.*, the English, the process has been very rapid, since side by side with individuals who have but a little craving for alcohol are found others with a very great craving, and since it frequently happens that parents who crave but little for the poison have offspring that crave very greatly for it, *i. e.*, offspring who have reverted to the ancestral type in which the craving was very great, the greatness of reversion being due to the swiftness of the evolution, owing to which reversion to a not very remote ancestor results in a considerable change of type."

Races which have undergone evolution through alcoholic selection are liable to retrogression when the stringency of that selection is abated. When the innately intemperate have as much influence on posterity as the innately temperate, alcoholic retrogression will ensue. Thus the success of every scheme for the promotion of temperance which depends upon the diminution or extinction of the alcoholic supply, or on voluntary or involuntary abstinence from alcohol, must result in an aggravation of the craving for that state of mind which

indulgence in alcohol induces. The craving for alcohol is like sexual love, an instinct, not an acquired trait. The love of alcohol is born anew with each generation, undiminished except by alcoholic selection.

It is practically impossible to banish alcohol from our midst, and since the craving for alcohol increases with indulgence, we cannot hope that moral influence will ever result in temperance, *i. e.*, in a moderate use of alcohol.

Why not banish alcohol as we do microbes? Because no man craves for disease, and thousands crave knowingly or unknowingly for excess in alcoholic indulgence. In the face of craving for alcohol, we cannot hope to banish that poison permanently. In relation to such a disease as tuberculosis which we cannot hope to permanently banish, we ought to forbid the procreation of the unfit. If alcohol were abolished, the time would surely come after the race had undergone retrogression, when any law would fall into abeyance from disuse. If temperance were founded on voluntary abstinence, the craving would eventually grow so ardent, as a result of retrogression, that no opposing traits would be sufficiently strong to counteract it. The course is to imitate alcoholic selection and eliminate those individuals who crave for alcohol to an excessive degree, at least in so far as to prevent them influencing posterity by leaving offspring.

"It is the same," says Reid, "in regard to the other narcotics. We find that the peoples who have used them the longest are less harmed by them, and have less craving for them than the people who are not accustomed to them."

The important question is, "Does evolution against one narcotic or intoxicant affect another?" It seems probable that the states of mind which these drugs induce are distinct and separate, just as the weakness against separate zymotic diseases are distinct and separate. Therefore it seems probable that a man may be strong against alcohol, but weak against opium, or *vice versa*, though a race accustomed to one may, if debarred from using it, go to greater excess in another, and the presence of one seems to shut out the others, especially when craving for the others has not been strongly awakened.

The foregoing views can be summarized briefly as follows:

The craving for alcohol is—

1. Sin;
2. Craving for relief from pain, nervous weakness or weariness incident to the struggle for existence;
3. Diseased appetite: the effect of an alcoholized protoplasm; a pathological perversion of physiological cell action in the cerebral cortex; a specific pathological craving which can be cured by a specific remedy;
4. A physical craving, an animal lust;
5. An acquired taste;
6. An organic appetite, made so by ages of indulgence, *i. e.*, a "secondary instinct;"
7. Instinct to intensify consciousness, to make wider variations in the mental life;
8. Desire to change the relation of common sense to individual sense;
9. An instinct which is a by-product of mental evolution.

Criticism of Theories of the Intoxication Impulse. All those

theories of the intoxication impulse which refer it back to the sinful nature of man are so uncritical and indefinite that they need no consideration.

The theory that the craving for alcohol is a habit which is becoming instinctive takes two forms. The first, which regards alcohol craving as a "secondary instinct," involves the transmission of acquired characteristics. One's attitude toward such a view would be determined at present by his position in regard to that problem. This theory attributes to the intoxication impulse an accidental origin, and its continuance to an accumulation of habit by inheritance. There are certainly no data to establish the theory. The second form of this theory, namely, that the craving for alcohol is due to alcoholized germ plasm does not require a belief in the transmission of acquired characteristics, but is in much the same condition as the first, as regards evidence. Environment is so complex as to make it usually quite impossible to trace a direct effect of inheritance in any given case. So far as the data studied in this paper are concerned they indicate that the craving for alcohol as such is not inherited at all. Probably no one now would deny that alcohol is capable of so affecting the parent directly as to cause degeneracy and disease in the offspring, and thus indirectly produce a tendency to the formation of abnormal habits, the indulgence in which alleviates pain temporarily. But that the germ plasm is so modified by alcohol as to produce an organism with a specific craving for alcohol is quite unsupported by any evidence. It is probable that the offspring of the opium eater is quite as likely to succumb to a craving for alcohol as the offspring of the alcohol drinker, other conditions being the same.

Cases in which there is said to be an inherited craving for alcohol, which appears even before any experience with it, need a very careful scrutiny before they are pronounced to be what they seem. One case related to the present writer by a physician will illustrate this point. A drunkard had two daughters, both of whom inherited from him a craving for alcohol. One drank at first moderately, then excessively and finally died from the effects. The other has never tasted alcohol but feels she has a craving for it. Many such cases of inherited craving are based upon just such an interpretation of feeling. It is inconceivable how one can have a craving for a thing which is totally outside of one's experience. Suggestion and fear are sufficient to account for all the facts. Another case will show how suggestion might misinterpret these longings. A man accustomed to careful introspection writes as follows: "I have never used alcohol in any form, but often in going by a saloon I have a desire to go in and get a drink. The sign,

"Frank Jones's Golden Ale," and the picture of the foaming glass, have a fascination for me especially on a hot day. Now I haven't the slightest idea what Frank Jones's Golden Ale tastes like. I may add that there is no history of alcoholism in my family." If this man had ever had the alcohol habit, or if there were a history of it in the family, he would have concluded, no doubt, that this longing was a deep-seated craving.

A very normal man of forty remembers as a child of not more than five having once drunk something from a peculiar looking bottle. He remembers distinctly noticing that the people present exchanged sly looks and were laughing at him. He remembers liking the taste of it, and afterwards looking many times for the bottle in order to have more of the drink which he now knows was cherry rum. As he grew up remembering this childish craving he for years believed that he had an inherited taste for alcohol, as there was a history of it in the family, his grandfather being a very heavy drinker. He has since used alcohol at times, moderately, and has no tendency to fall a victim to it.

The simplest explanation to all these cases is that the inherited craving does not exist at all and that suggestion accounts for the whole matter. The facility with which alcohol habits can be exchanged for other similar habits, the effectiveness of cures which act upon the mental processes, the abrupt cessation of the craving when alcohol cannot be obtained, all point to a single conclusion, namely: that the craving for alcohol is concerned with the mental rather than with the physiological aspect of development. The claim that the effect of alcohol upon the system is to produce such a condition of the tissues that it requires greater and greater quantities to produce intoxication is by no means substantiated, especially in cases where there are considerable periods of abstinence. Waugh[1] denies the statement that drug users increase the dose because it takes more and more to produce exhilaration. He says that all whom he has questioned have confessed that they increase the dose because they desire more of the feeling. The same was found to be true in some alcohol cases at least. Some say that less is required to intoxicate as the habit progresses. In cases where drinking is steady day after day, however, there seems to be a capacity for consuming with comparative impunity larger and larger quantities. In cases of relapse after cures by the Keeley and other methods, sudden deaths are due no doubt, to the inability of the system to consume quantities of alcohol which were readily disposed of after long practice.

The strongest evidence against the view that "alcoholized

[1]Cocaine Addiction, *Jour. Inebriety*, Apr. 1898. Vol. XX, No. 2, p. 192.

protoplasm" is the physiological basis of the craving for alcohol, is furnished by abundant testimony that the young drinker is far less amenable to treatment than the old drinker, which could hardly be the case if a slow process of poisoning produced the craving. The sudden cures, especially the psychical cures, also offer evidence against this view. The widespread belief in the deep seated nature of the alcohol craving, that it is a "part of a man's body," etc., has had in the past a pernicious effect. The belief that a habit is incurable does more than anything else to compel its continuance. Cases quoted above show this, and also the effect of the opposite belief (that the habit is broken) in effecting a cure.

The facts brought forward in preceding sections sufficiently prove that the pain in the world is not sufficient to account for the prevalence of intoxication and drunkenness. There can be no doubt that pain is one of the most important causes of drunkenness—but it is not the only cause, and the great intoxication motive in its origin and development is not connected with pain at all, but rather with pleasure. The theory that alcohol craving is an "animal lust" or a physical craving is too indefinite to admit of discussion.

The theory that alcohol is used because it causes wider variations in life, which is otherwise too monotonous, expresses vaguely an important psychological factor in intoxication, as does also the view that alcohol changes the relation of common to individual sense. Beard's theory of the close connection between high mental development in a race and a love of stimulation also accords with the view upheld in this paper.

Reid's theory that the craving for alcohol is a specific craving, a by-product of mental evolution, that it exists in every one, whether he is aware of it or not, and that it is in process of gradual elimination from the race by a selection against it is out of accord with the facts. The transferableness of the alcohol habits for other habits show that it is not such a specific craving. Even though it were true that in nations which have been long accustomed to alcohol there is less craving for it than in nations in which the habit has been recently acquired, this does not prove that the relation is one of cause and effect. It is probable, as Reid says, that a process of elimination of the most unfit in regard to alcohol, as of those who are unfit in other respect, has been going on slowly. But this is inadequate to account for the differences in the drink craving of the individuals of different nations. The history of nations shows also that the elimination of the alcohol craving has not been a uniform process. As we have seen, times preceding eras of high culture have been times of gross intoxication, temperance has come with the highest culture, and then intemperance again

as the nation decayed. Lower races which have long been accustomed to native alcoholic beverages perish in the presence of the stronger drinks of civilized men, showing that their long acquaintance with alcohol has not eliminated the craving for it. It is well known that Europeans, especially Italians (who, Reid says, have not a strong craving for alcohol), on coming to America readily succumb to the drinking habits of the country.

There is nowhere in the history of drink an account of the sudden introduction of alcohol into a civilized country. In that case, we should expect if Reid's theory is correct, the most disastrous effects, for no degree of civilization would be in the least a safeguard against it in the absence of a long period in which selection had been at work to eliminate the craving. A good example of this, though not on a national scale, is to be found in the case of families which have been abstainers for a number of generations. On Reid's theory we should expect that the descendants of these would be weak in the presence of alcohol. This does not appear to be true; in fact quite the opposite conclusion is warranted.

The sudden introduction of alcohol into a nation in such a state of growth as that of our own country at the present time, if it were possible, would probably not, as Reid says, result disastrously, for the reason that selection has already produced, in connection with general advancement of civilization, those qualities of control which antagonize all forms of destructive habits.

Reid's theory is constructed out of the analogy which he draws between zymotic diseases and habits of a mental nature, assuming that the latter are as specific as the former. This is the error upon which the other errors of the theory, as well as of its practical conclusions are based. The most valuable part of the theory is the term "by-product of mental evolution," which, though in itself explaining nothing, calls attention to the relation between the alcohol craving and normal mental development. Upon that relationship the view of the present writer is based.

§ 8. Summary of Facts and Outline of a Theory of the Intoxication Impulse.

Some of the facts concerning intoxication which must be taken into account by any theory of the intoxication impulse are the following: (1) Intoxication is one of the most important parts of the religious and social life of primitive man. The use of alcoholic beverages arose in connection with the religious social life in the effort to heighten the religious social-consciousness. Its use for these purposes among primitive peoples is widespread

and almost universal. (2) The drugs which have been widely used for intoxication purposes are capable of producing quite different effects. They may either increase or decrease the *intensity* of consciousness. (3) The state of intoxication is essentially a succession of emotional states having a distinct climax. In the pleasure stage the consciousness of self is increased, and the external world diminished in importance. (4) The historical importance of intoxication is shown by the deep impression it has made upon the literature and language. (5) The history of intoxication shows that it has been exceedingly prevalent at times of rapid development. In the individual intoxication habits are most likely to be formed during adolescence, and during this period they are more difficult to overcome than later in life. (6) The study of individual cases shows that taste is a small factor among the causes of the intoxication habit. The craving for alcohol is not a physical craving, but is essentially a craving for a mental state. The drunkard does not recognize the craving as a specific craving for alcohol, and when for a time alcohol cannot be obtained there is little left in consciousness of the craving. There is also evidence to show that the alcohol habit and the other drug habits are readily interchangeable. A man can be cured of one by substituting another. (7) The whole history of intoxication shows its close connection with the social-consciousness. The feeling is so strong that many habitual drinkers regard it as disgraceful to become intoxicated when alone. (8) A study of analogues of the intoxication state leads to the view that there has grown up in the race a strong impulse to seek intense states of consciousness, and that this impulse has been favored by natural selection for several reasons.

The results of a necessity for a strong impulse to seek intense states of consciousness and a consequent centering of selection upon this impulse may be summed up as follows:

1. An increasing instinctive tendency to seek intense states of consciousness.
2. An increasing capacity for self-control. (A capacity for intense mental activity plus an adequate control is the condition of highest efficiency.)
3. A greater capacity for pain and a tendency to revert to more primitive states of consciousness.
4. An increasing number of defective and abnormal cases.

The intoxication impulse is to be regarded as one form of expression of the general instinctive tendency[1] to seek intense

[1] In regard to general instinctive tendencies the following from Groos is in point. At the moment when the intelligence reaches a point of development where it is more useful than the most perfect instinct, natural selection will prefer individuals in whom instinct appears only

states of consciousness, and not as an independent impulse which has become instinctive by reason of centuries of indulgence, nor an instinct which has grown up as a by-product of mental evolution. The prevalence of the special form of the expression of this general impulse in intoxication has probably been greatly favored by the assistance which it has given to the social consciousness.

The desire to revert to more primitive states of consciousness, accompanying a condition of high pressure, is the impulse which appears everywhere in the literature of drink as the narcotic motive. This tendency of man to look behind him has placed the golden age in the past; it has created mythic accounts of Fountains of Youth, of Paradises in remote lands, of Utopias and Nirvanas. All these are expressions of fatigue, of a longing away from a too tonic environment. This spirit is the keynote of mysticism, the constant theme of which is rest; to be relieved from weariness and pain. The cry of "back to nature," which is raised when the weight of the accumulated culture and conventionality becomes burdensome, is another expression of this impulse. Rousseau is as good an example as any one of this tendency in philosophy; in his case there is plenty of evidence to show that the psychological foundation of his hatred of society and his worship of nature was an abnormal physical condition. The same psychological foundation must be attributed to much of the *laissez-faire* ideal as it appears in education and ethics. Nietzsche[1] sees the true nature of this motive, hence his contempt for pity. "What we need," he says, "is pain, more pain." Again he speaks of the two great European narcotics, Christianity and alcohol; these he places together, doubtless because he recognizes in both the impulse to seek an artificial means of escaping pain, in both a means of compensating for or palliating the sternness of reality. "Pain spurs the nervous system on," Mosso says. It creates states of second breath. The seeking of artificial means of alleviating it whether it be by narcotics, by the over-development of the social consciousness, or by socialistic schemes is an expression of the longing backward, away from the influence of natural selection and the struggle for existence. This is an impulse common to all minds in a degree. It appears in normal relaxation, in reverie, and in sleep, all of which states considered from the standpoint of evolution are reversions. The narcotic impulse is well expressed in the hedonic narcosis, which is pessimistic, representing a desire to escape from the will to live; intoxication, on the other

in an imperfect form, manifesting itself in early youth in activity purely for exercise and practice. The Play of Animals, p. 44, preface.

[1] Ellis: Affirmations.

hand, is optimistic and symbolizes the will to live. The relationship between optimism and intoxication is touched upon by Parker,[1] in an article on the psychology of belief. "Excitement of any sort," he says, "seems to quicken conviction. Stimulants arouse belief. Belief is an expression of the instinctive force of life."

It was found that all stimulant-narcotics were capable of affecting the consciousness in two opposite ways. They can increase or diminish its intensity; this characteristic coincides with the facts in regard to the motives which lead to their use. In accordance with an evolutionary standpoint the drunkard is to be regarded (1) as one in whom the craving for intense states of consciousness is over-developed, or who is lacking in control; (2) as one who (usually as a result of pain) has an abnormal craving to revert to a state of consciousness which is less intense.

(It matters little, however, whether in the last mentioned case the impulse be regarded as a true instinctive tendency which has grown up in connection with other instincts which have favored mental development, or whether the painful state be regarded as simply the cause or occasion of an abnormal activity of a normal instinctive craving.)

To sum up this evolutionary theory: the intoxication impulse is not a physical craving nor a specific impulse but it is one form of expression of a general instinctive tendency, which has developed in the race as an aid to mental growth. This impulse is not merely an expression of a surplus of energy but is instinctive. In explaining the prevalence of intoxication, there must be taken into account, also, the narcotic effect of intoxicants, and also an impulse to revert to a less intense form of life.

A single general conclusion may be stated as follows: The most determining factors in the life of man are not the definite, specific instinctive impulses which appear to govern to a greater extent the actions of animals, but certain general impulses which are innate. These tendencies are exceedingly plastic, and probably those impulses which have been developed for the purpose of accelerating mental growth and those impulses which seem to determine long continued and definite lines of conduct are the most plastic of all. It is possible that too much has been made of the rigidity of habits and also of the limits of the range of the human instinctive activities in general. A practical conclusion which results from such theories as those of Reid, who maintains that the craving for alcohol is a specific craving, has been mentioned above, namely, that the only way in which

[1] *Popular Science Monthly*, Vol. LI, p. 749, 1898.

man can become safe in the presence of alcohol, is by a process of selection, which will weed out those who have the craving for it in an abnormal degree. This process can be accelerated by allowing all to have an opportunity to test their control, and by preventing those who fail from generating offspring. If alcohol is abolished from the world, the craving (increased by the removal selection) will cause a disastrous return to drinking at some future time.

Such a view receives no support from the evidence of the present study. In fact quite the opposite practical conclusion is indicated. If the craving for alcohol is one expression of a general instinctive tendency, the selection which continually favors the type of mind which craves intense consciousness also favors a general self-control, so that a process of evolution would go on in the entire absence of alcohol until such a high degree of general control was developed that alcohol, if then suddenly introduced, would have little effect except upon the minority who were constitutionally unfit in other respects, as well as in the matter of resistance to alcohol. There probably is no reason derived from an evolutionary view why alcohol should not be entirely abolished from the world, and the craving which it satisfies be turned into some more useful channel. Its social need is no longer apparent, in fact, it now on the whole favors an over-development of the social consciousness which is harmful to a great many. It is a mistake to think that free access to alcohol decreases the number of the unfit in regard to it, for the reason that in exposing all to this selection, many whole families are injured from which weakness might otherwise be eliminated in a few generations; for a slight degree of craving on the part of a parent may, if indulged, produce degeneracy in the offspring, by direct effect of the alcohol, while many others are indirectly injured. Evolution of control of all such habits as the alcohol habit would therefore go on much faster in the entire absence of alcohol as a factor in selection. The removal of painful conditions, and the utilization in useful channels (rather than the suppression) of the plastic impulse which causes intoxication are the pedagogical lines indicated by the present study.

It was stated at the outset that the interest in the present problem grew largely out of a desire to test the value of psychological methods in dealing with certain ethical problems. Any one of a large number of impulses which are important because they determine morbid conduct might have been chosen for similar study, as for example, the gambling impulse, envy and jealousy, or the sexual impulse.

It may well be maintained that a psychological standpoint is too limited, and that these suggested problems of ethics are

larger than psychology. That would readily be granted. Indeed it seems inevitable that ultimately a broad biological method must be adopted (based upon a monistic philosophy) in which the individual is the unit, and in which psychological and physiological data will be placed on equal terms and supplement or mutually explain each other. If we are willing to adopt such a monistic hypothesis, the impulses and instinct feelings, their differences from individual to individual, and their changes in the same individual are to be regarded as the correlates or reverse side of exceedingly complex anatomical, physiological, and chemical factors. To attempt at present to study ethical problems from the side of the physical sciences, is to be hopelessly lost. There remains the psychological approach, and its advantage consists in the fact that the psychical elements to be studied, the impulses, are comparatively simple, unified, or synthetic expressions of very complex physical and chemical conditions. For these reasons it is probable that for a long time to come psychological methods will be of most service in the study of ethical problems.

II.

EFFECT OF SMALL DOSES OF ALCOHOL UPON THE ABILITY TO DO MUSCULAR AND MENTAL WORK.

§ 1. Résumé of Recent Literature.

Kräpelin's[1] studies began with one on the effect of alcohol upon reaction times. Doses of from 25 to 60 grams were used, and four subjects were tested. There was a shortening of the time under the influence of small doses of alcohol, and an increased shortening with an increase of the dose up to a certain limit. The increase began to appear during the first five minutes, and reached its maximum during the first twenty minutes. With a larger dose the reaction time was lengthened, or the period of increased speed was shortened, and there was a greater lengthening of time with an increase of the dose. In all but two cases when there was an initial shortening of the time, there occurred later a lengthening of the time beyond the normal. Dietl and von Vintschgau[2] used from ½ to 1 bottle of champagne, and found that if the "quantity be not very great" the reaction time is shortened for a certain period. The quickening

[1] Kräpelin: Ueber die Einwirkung einiger medicamentöser Stoffe auf die Dauer einfacher psychischer Vorgänge, *Wundt's Studien*, 1883.
Kräpelin: Ueber die Beeinflussung einfacher psychischer Vorgänge durch einige Arzneimittel, 1892.

[2] Dietl und von Vintschgau: Das Verhalten der physiologischen Reactionszeit unter dem Einfluss von Morphium, Caffee und Wein, *Pflüger's Archiv*, XVI.

lasts longer when the wine is drunk slowly and in small quantities.

Exner[1] found that one bottle of Hochheimer changed the reaction time from 0.1904 sec. to 0.1997 sec., and a second bottle caused a still further slowing to 0.2884 sec., and later to 0.2969 sec.

Warren,[2] using varying quantities of absolute alcohol, comes to a negative result, and concludes that although the results suggest that the reaction time may be quickened after alcohol, and that the later effect is in the direction of a slowing, such a conclusion is not fairly established by his own observations, and, indeed, it is hard to make out any effect of alcohol on simple reaction times.

Several experiments have been made upon the effect of alcohol on the power to make muscular contractions. Lombard[3] found that the taking of whiskey or claret was always followed by increase in the muscular power. No depressing after-effect was observed. He found, however, that the muscle when stimulated by electricity contracted with less force after alcohol had been taken, at the same time that the voluntary contractions were increased in force. His conclusion that the contractility of muscle-tissue is decreased by alcohol is confirmed by Hemmeter's[4] experiments upon the effect of alcohol on the isolated heart.

Kräpelin's dynamometer tests show nothing conclusively. With one subject alcohol caused an increase in the muscle power, and in the other it caused a decrease. Two other experimenters have recently published the results of tests with the ergograph upon the muscular power, the studies being primarily to determine the comparative effect of alcohol upon fatigued and fresh muscles. Frey[5] finds that the power of a fatigued muscle increased after the taking of alcohol, while in the fresh muscle there was no change. Destrée[5] repeated Frey's experiments, alternating normal with alcohol tests, 10 grams of absolute alcohol being used. He found that in both fresh and fatigued muscle there was a rise in the curve, occurring from one to two minutes after the taking of alcohol. This increase lasted from

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[1] Exner: Experimentelle Untersuchungen der einfachsten psychischen Processe, *Pflüger's Archiv*, VII.

[2] Warren: Alcohol and Reaction Time, *Journal of Physiology*, Vol. VIII, pp. 311-348 (1887).

[3] Lombard: Some of the influences which affect the power of voluntary muscular contractions, *Journal of Physiology*, Vol. XIII, No. 1 and 2, 1892.

[4] Hemmeter: Comparative effects of certain members of the ethylic alcohol series ($C H_4 O$ to $C_5 H_{12} O$) on the isolated mammalian heart.

[5] Reviewed in the *Correspondenz-Blatt für Schweizer Aerzte*, XXVII, No. 2, Nov. 15, 1897, p. 675.

10 to 30 minutes. Then there was a drop in the curve, and it finally sank below the normal. The larger the dose of alcohol the more rapid the onset of the depression and the longer its continuance.

Taking all the foregoing experiments into account, it seems that for those processes which are predominantly motor, the effect of moderate doses of alcohol is at first to cause an increase in the power and then a decrease,—or a quickening followed by a slowing, if the question is one of time. The experiments of Lombard, and those of the writer, presently to be described, furnish some evidence for the conclusion that, at least in the case of the subjects tried, a dose of alcohol may be made small enough to cause a stimulating effect, which is not followed by a depression, or after which the depression is very long delayed.

Processes of a mixed or predominantly sensory or associational type, are more difficult to experiment upon and the results are less definite. Aschaffenburg[1] has recently made a study of the work done by four typesetters on abstinent and alcohol days. His subjects were all beer drinkers, but abstinence was maintained for the purposes of the experiments. Doses of two hundred grams of an 18% Greek wine were used, administered after the first 15 minutes' work. Less work was done in an hour on alcohol days than on abstinent days. In all cases but one the amounts done on alcohol days fell below the estimated expectation and in each case the total amount of work done on an alcohol day was less than that done on an abstinent day. There was no qualitative change in the work. Smith,[2] using from 40 to 80 grams of alcohol, given in small doses throughout the day, tested the ability to add and to learn nonsense syllables. Groups of alcohol days were alternated with groups of normal days. The effect of the first day's alcohol was to paralyze the power of improvement. After some days there appeared a summation effect, and less work was done each day than on the day before. An after-effect was apparent eight days after the alcohol series ended, for, on its resumption, the work fell off much more rapidly than during the first series. Nonsense syllable learning was affected more than adding. In the latter case, less than a third as much work was done on the last alcohol day as on the first.

Kräpelin in his experiments upon mixed processes found variable results. In the adding tests, all seven subjects showed an increase at first. In learning twelve place figures a similar increase appeared in every case. In reading, the total amount

[1] Kräpelin's *Psychologische Arbeiten*.

[2] August Smith: Die Alkoholfrage und ihre Bedeutung für Volkswohl und Volksgesundheit.

done was increased by alcohol in all but two cases. In all these experiments, alcohol caused a greater irregularity and variation in the work product. Tests upon the quality and rapidity of association showed a change in the character of the reactions. There were greater irregularities in the alcohol series and more "outer" associations. Averages for a series of twelve days show that on the whole the association time was longer on the alcohol than on the normal days. Kräpelin concludes that alcohol tends to increase association time. Still his tables show that there was sometimes a shortening of the time, as an initial effect. From his whole series of experiments, he concludes that while the effect of alcohol in moderate doses upon the motor processes is to cause an initial stimulation, and then depression, and in larger doses depression from the start, the effect upon all sensory processes is depression. The variations from this law in the processes tested Kräpelin thinks may be accounted for by the presence of a motor factor in the processes.

§ 2. Experiments of the Writer.

The writer's own experiments, performed chiefly on himself and with small doses of alcohol, bear upon two points: (1) The effect of alcohol upon physical work with the ergograph; and (2) the effect upon the psychophysical processes of adding, reading, and writing.

A. *The Effect of Alcohol upon Work with the Ergograph.*

Apparatus and Methods. The ergograph used was a Salter's hand dynamometer securely fastened in a horizontal position on a table and provided with a writing point attached directly to its shaft. A record of the usual form was thus obtained upon a kymograph drum, while an endless tape, similar to that described by Lombard,[1] was also attached to sum up the contractions.

The method was the following: One hundred maximum contractions were made, at intervals of 1.6 sec., a metronome marking the time. The remainder of a ten minute period (7 m. 20 sec.), was used for rest. The round of work and rest was then immediately repeated. Six of these rounds (six hundred contractions in all) were made in an hour. The time of day for experimenting was from 8 to 9 A. M. On days when alcohol was taken the dose was 90 grams (in a few preliminary tests 60 grams and 45 grams), of a 33⅓% alcohol, and was taken five minutes before work began. By preliminary practice the hands and arms were hardened to the work.

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

Results. The ergographic experiments fall into three groups. (1). In the first group experiments were made upon two subjects, H and P. H worked thirteen consecutive days, two hours per day, from 8 to 9 in the morning, and from 5 to 6 in the afternoon. On the fifth, sixth, seventh and eighth days 60 grams of 33⅓% alcohol was taken, both morning and evening. For the four alcohol days the average for a single round (100 contractions) is 100.6 cm. (mean variation, 3.0). For nine normal days, five preceding and four following the alcohol days, the average is 105.6 cm. (mean variation, 2.6). The averages for the even ing work are, for the alcohol days, 104.9 cm. (m. v., 1.1) for six normal days, three preceding and three following the alcohol days, 108.7 cm. (m. v., 2.2), showing less work done in each case on the alcohol days.

The results of H's[1] work, given by rounds, follows.

Table showing average for each round for morning and afternoon work on normal and alcohol days, Subject H.

	ROUND 1.	ROUND 2.	ROUND 3.	ROUND 4.	ROUND 5.	ROUND 6.
Normal 9 days, A. M.,	107.3 (4.2)	108.5 (4.1)	106.2 (3.3)	105.1 (3.5)	102.9 (4.1)	103.6 (4.1)
Alcohol 4 days, A. M.,	104.1 (6.5)	102.3 (4.0)	100.4 (4.6)	100.2 (3.0)	98.0 (2.9)	100.9 (2.1)
Normal 7 days, P. M..	110.8 (5.0)	108.9 (5.0)	110.5 (2.8)	109.2 (3.0)	106.2 (2.4)	106.7 (1.9)
Alcohol 4 days, P. M.,	109.0 (1.2)	108.6 (1.2)	105.9 (2.5)	103.2 (1.4)	101.6 (.9)	101.8 (2.3)

Subject P[2] worked 25 days between December 10, 1897, and January 8, 1898. December 11 to 20 and January 5 to 8 were normal days. On December 21, 22, 23, 24, 30, 31, and January 1, 2, 3, 4, 45 grams of 33⅓% alcohol was taken five minutes before work began. The average for the first four alcohol days is 77.5 cm. (m. v., 3.2): for the four preceding normal days the average is 78.0 cm. (m. v., .7). The average for the alcohol days, from Dec. 30 to Jan. 4, is 101.7 cm. (m. v., 2.1), and for the eight nearest normal days 101.7 cm. (m. v., 7.1), showing that the total amount of work done was not affected by the alcohol. When, however, the averages for each period of the alcohol days are placed beside the averages for the normal days so as to show the typical fatigue curve under each condition, a result is obtained which appears also when the averages are taken separately for the two groups of alcohol days and the nearest normal days, namely, a slight but regularly increasing stimulating effect of the alcohol.

[1] H is a man of 37 in excellent health. The results are given for convenience in terms of centimeters as registered upon the tape. A centimeter equals, approximately, a pull of 100 pounds.

[2] Man of 27 in good general health, of nervous temperament.

(2). The second group of experiments extended from January 9 to February 25, 1898, and was made by subject P alone. The experiments were performed between 8 and 9 in the morning. Ninety grams of 33⅓% alcohol was taken. The order of days was as follows: Jan. 9-11 and 13-14 normal; 15 and 16 alcohol; 17 and 20 normal; 21 and 22 alcohol; 24 and 26 normal; 27 and 28 alcohol; 29 and 31 normal; Feb. 1 and 3 alcohol; Feb. 4 and 5 normal; 7 and 8 alcohol; 9 and 14 normal; 16, 19 and 21 alcohol; making a total of 16 normal days and 13 alcohol days. The averages for the whole series are normal 108.6 (m. v., 4.3), alcohol 108.7 (m. v., 6.6), showing, as before, no appreciable effect of the alcohol upon the total amount of work done. When, however, the work of the ten-minute periods is not thrown together into a general average, but taken separately, the effect of the alcohol is clear in a slight increase, followed by a slight decrease of power, which happen in this case to compensate each other. The following table shows the average for the ten-minute periods separately, with the effect of the alcohol:

Period.	I.	II.	III.	IV.	V.	VI.
Normal days,	107.5 (.99)	110.8 (1.25)	109.7 (1.20)	108.6 (1.13)	108.0 (.99)	106.8 (.74)
Alcohol days,	108.3 (1.40)	115.1 (1.89)	111.0 (1.65)	107.7 (1.69)	105.9 (1.73)	105.0 (1.59)
Effect of Alcohol,	+.8	+4.3	+1.7	−.9	−2.8	−1.8

The table shows that there is a stimulating effect due to the alcohol which lasts during the first half hour, and then a depressing effect which persists until the end of the work period. Comparison of the amount of work done on alcohol days, taking the days themselves in two sections, confirms the results given in the table.

The pulse rate was taken by the subject for the first three minutes of each rest period. The average results for 26 days show a quicker pulse on the alcohol days—less than two beats in a minute, except in case of the second ten-minute period, when the difference is slightly over three. The average for the whole series of days is, for the normal days, 115.6 (m. v., 4.8), for the alcohol days 117.3 (m. v., 4.9). Dividing the whole series of days into two periods, and averaging them separately, gives similar results.

(3.) The experiments just considered show the effect during the hour immediately following the taking of the alcohol. Those of the third group were undertaken to show the effect during the second hour. They were made, however, under somewhat different conditions. The method was the same as before, except that the number of contractions was 50 instead of 100, and that

during the rest periods mental tests were made. The same amount of alcohol was used, but the first hour was filled with other tests, and the muscle tests did not begin till the second hour, *i. e.*, the alcohol was taken at 7.55 A. M., and the muscle tests were made between 9 and 10 A. M. The groups included 20 normal and 10 alcohol days, and the order was N. A. N., N. A. N., etc.; an alcohol day between two normal days. The total amount of work on the alcohol days falls short of that on the normal days, and less work was done in each of the six periods. The averages for the whole hour's work are: normal 70.2 (m. v., 3.2), alcohol 68.6 (m. v., 3.8). The averages for the first half hour are normal 73.0, alcohol 71.3, and for the second half hour normal 67.4, alcohol 66.0.

The results by periods are given in the following table.

Table showing the effect of alcohol upon muscle work during the second hour.

ROUND.	I.	II.	III.	IV.	V.	VI.
Normal 20 days,	71.0 (.73)	75.2 (.80)	72.8 (.73)	69.4 (.72)	67.3 (.68)	65.5 (.73)
Alcohol 10 days,	70.4 (.63)	73.3 (1.17)	70.4 (1.61)	67.8 (1.42)	66.0 (1.37)	64 2 (1.10)
Loss,	—.6	—1.9	—2.4	—1.6	—1.3	—1.3

Summary of Effect of Alcohol upon Muscular Work. The effect upon subject H of 60 grams of 33⅓% alcohol, taken just before work began, was to decrease decidedly the working power.

Forty-five grams did not affect the amount of work done by subject P, but a comparison of the curves for normal and alcohol days indicates that the alcohol produced a slight, but steadily progressive stimulating effect.

Ninety grams also failed to affect the total amount of work done by P, but in this case the effect is clear in an alteration of the work curve. There is an increase in the amount of work done during the first half hour on the alcohol days, and a decrease during the second half hour.

The effect of 90 grams upon the amount of work done during the second hour after the alcohol was taken was to decrease the amount, which was less for each period during the hour.

B. *The Effect of Alcohol upon the Rapidity of Adding, Reading, and Writing.*

The experiments upon these processes covered a period of thirty-three days, being carried on simultaneously with those last described. The amount of alcohol taken was 90 grams of 33⅓%, taken at 7.55 A. M. Work was begun at 8 A. M., and

continued until 10 A. M. During the first hour there were six 10-minute periods of tests made in the following order: adding, reading, tapping, writing. The apparatus used for tapping proved unsatisfactory, and, although the tapping was continued in order not to alter the conditions for the others, it will not be considered here. The tests occupied approximately 7 minutes of each 10-minute period. The remainder of the period was given to rest. For adding, sheets containing 16 columns of figures, 25 in each column (400 in all) were used, the same sheets being used each day, but in a different order. The reading test consisted in reading audibly at a maximum rate, the figures which had just been added. For a writing test digits from one to nine were written at maximum speed, preliminary practice having been made in order to acquire a uniform movement. During the second hour the same order of tests was followed except for the insertion of the ergographic work described above.

Adding. The average adding time for the whole series is normal 162.3 sec. (m. v., 7.4 sec.), alcohol 160.9 sec. (m. v., 6.9 sec.); for the first hour, normal 163.0 sec. (m. v., 7.0 sec.), alcohol 161.2 sec. (m. v., 8.7 sec.); for the second hour, normal 161.7 sec. (m. v., 7.1 sec.), alcohol 160.7 sec. (m. v., 5.6 sec.).

The effect of the alcohol is slight, but so far as it appears is rather in the direction of a quickening of the process than the reverse.

Reading. The averages for the whole series are normal 94.2 sec. (m. v., 2.6 sec.), alcohol 94.2 sec. (m. v., 1.9 sec.); for the first hour, normal 94.0 sec. (m. v., 2.4 sec.), alcohol 93.7 sec. (m. v., 1.8 sec.); for the second hour, normal 94.5 sec. (m. v., 2.7 sec.), alcohol 94.7 sec. (m. v., 2.2 sec.).

Here, as in the case of the ergographic work, the effect is first a quickening and then a slowing (both insignificant and mutually compensating in the general average, but appearing when the course of the work is considered). By subtracting the reading time from the adding time, the time consumed by the association process in adding is obtained approximately. The results obtained in this way bring into greater relief the effect of the alcohol which appears in the results of the adding test, namely, a quickening of the process.

The averages for the whole series are normal 68.0 sec. (m. v., 5.6 sec.), alcohol 66.7 sec. (m. v., 6.5 sec.); first hour, normal 68.9 sec. (m. v., 5.6 sec.), alcohol 67.5 sec. (m. v., 8.9 sec.); second hour, normal 67.1 sec. (m. v., 5.5 sec.), alcohol 65.9 sec. (m. v., 5.5 sec.).

Writing. The average number of figures written in each period is, for the whole series, normal 225.2 (m. v., 14.2 sec), alcohol 225.8 (m. v., 15.1); for the first hour, normal 221.6 (m.

v., 14.3), alcohol 224.3 (m. v., 16.5); second hour, normal 228.9 (m. v., 15.6), alcohol 227.4 (m. v., 14.5).

The difference is again hardly perceptible, but so far as it appears, the effect of the alcohol is a quickening of the work during the first hour, followed by a slowing during the second hour. As regards the quality of the work, the results are uncertain.

In summary of all these psychophysical tests it may be said that the effects of the alcohol are slight, but that in adding, which is mainly an association process, the alcohol seems to produce in general a slight quickening which lasts nearly to the end of the second hour, and in reading and writing, which involve more muscular action, the effect resembles that found with the ergograph, namely, a period of quickening followed by a period of retardation. These results do not confirm Kräpelin's conclusion that the 'sensory' process (adding is regarded by him as a "sensory" process) is depressed by alcohol from the start, while the motor process alone is at first stimulated. In fact the opposite seems to be true. The association process is quickened while the motor processes appear to be more likely to be slowed by the alcohol. It could not be discovered in any case that the depressing effect of the alcohol persisted until the following day.

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TWO CASES OF SYNÆSTHESIA.

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Many accounts have been published, in scientific and popular form, of the phenomena of synæsthesia, and chiefly of the form known as colored hearing. While the popular accounts are, as usual, untrustworthy and meagre, even the scientific publications are, with the exception of a few detailed descriptions, rather attempts at cataloguing than systematic investigations into the nature of the individual cases treated. For this reason it seemed worth while to make a careful and extended study of the two cases which form the subject of this paper. Although similar tests were given to both subjects, the reactions were so dissimilar that the treatment must needs be separate.

CASE I.

The first case is that of *M* (Miss M. F. McClure), a senior student in the Department of Psychology. While serving as subject in an experiment upon the qualitative discrimination of clangs as conditioned by time interval, *M* developed a form of judgment which was clearly based upon secondary visual criteria. The two given tones of the Appunn tonometer were followed by the appearance in the visual field of the closed eyes of light lines arranged horizontally against a luminous background, at times vaguely tinged with color, usually with pink or green. The higher tone generally appeared as a horizontal line above the lower; at times the line of the lower tone was darker. Later, in the course of experimentation, the ladder formation was less frequent. The tones, however, as a rule occasioned clouds of color, though the colors themselves did not always form a basis for judgment.[1] The frequency and vividness of these visual concomitants suggested the systematic investigation of the case.

[1] The variety of combinations reported is too large to admit of detailed mention. The following is a piece of introspection taken at random from the record: "The first tone was high up in the visual scale, of greenish color (while the tone lasted), with the impression of a ladder formation. The second took its place below the first and determined the judgment."

§ 1. *Historical.*

No trace of colored hearing can be found in the other members of the family. The hypothesis of heredity[1] seems also to be refuted by the fact that the first instance of the phenomenon was quite sudden and hallucinatory in character, and of late origin. In *M's* own words:

"In 1894, at the age of 16, I heard Melba sing the casket (jewel) song in *Faust*. My eyes were wide open. Suddenly I saw a greenness, rich and flowing. It seemed to move as if it were almost liquid, and occasionally it sparkled. It flowed downward obliquely from right to left, and seemed to correspond to the character of Melba's voice. I was not looking at her at the time. The color was not a tint of green of which I am especially fond, but it was very vivid and beautiful. I had been anticipating Melba's singing for some time. Shortly before, I had heard Nordica, but had no visualizations."

After this experience colored hearing, especially with emotionally stirring music, became quite frequent. The colors are not obtained by a deliberate attempt to see them; indeed, such an attempt rather tends to prevent their appearance. In general they are luminous, diaphanous clouds of color (though at times in definite figures) floating over a dusky background; and they are always seen projected[2] to a position about 20 cm. from the eyes. They rarely cover the whole field.

The photisms seem to have been neither a hindrance nor yet any particular help to the subject (apart from their use in discrimination, as above mentioned); yet they are pleasant, and add considerably to the enjoyment of music. That they are unequivocally conditioned by tones is evident from the fact that *M* never experiences colors of the kind in daylight, except when hearing music, and that they appear and disappear with the appearance and disappearance of the tones which call them up.

It may be further said that the phenomena are but one feature of a general mental tendency to rich and varied associative supplementing, which is exhibited, as will be shown later, by abundant personifications, metaphor and simile. The linking is obviously emotional. "This tone makes me 'feel' like this color." "When I try to feel like the letter C, I feel that it must be very pleasant and good-natured."

M has a generally keen and vivid visual imagery. She is able, *e. g.*, to analyze the color tones of grayish objects. Thus sand is not seen as silver-gray alone, but also as tinged with

[1] Bleuler u. Lehmann, Zwangsmässige Lichtempfindungen durch Schall, p. 49.

[2] This stamps Case I as belonging to the first type of Flournoy (Les phenomènes de synopsie, p. 9), in which the induced photism is objective.

blue and yellow and a little red. Oiled floors often have beautiful blues and reds. Her limen for the discrimination of gray figures in episkotister work is lower than the average. Nearly all shadows are colored. *M* has actually seen the "purple cow," —a red cow standing in a shadow which was bluish, in contrast to the yellow tone of the illuminating light. This tendency to analysis makes the subject see the landscape somewhat as an impressionist would paint it. As might be expected, colors have for her a high degree of affective tone—a certain corridor finished in browns is, for example, very depressing. This fact is of significance in view of the further fact that the photisms are conditioned by the affective value of the correlated sounds.

§ 2. *Experimental.*

(1.) *Retinal colors.* In order to differentiate the photisms from the retinal light, several series of tests were made, in which *M* was seated in a noiseless dark room. After a wait of several minutes, for adaptation, the changes in the visual field were telephoned to the experimenter in another room, who recorded them, together with their time of appearance and duration as indicated by a stop-watch. One such series will suffice.

TIME.		VISUAL PHENOMENA.[1]
MIN.	SEC.	
0	0	Very faint G.
0	20	G gone.
0	30	Dappled background of brightness.
1	00	Strip of B of high Satn.
1	05	Strip of B losing Satn.
1	35	Two strips of brightness in continuous slow movement,
1	50	One strip gone,
2	00	YG welling up.
2	10	YG gone.
2	30	Faint B.
2	35	Faint B gone.
2	45	Faint B back.
2	53	B changed to G.
3	10	G changed to YG.
3	18	YG gone.
3	33	Faint horizontal strip B.
3	55	B, high Satn. Pretty in spots. The rest as through a veil.
4	20	B spreading.
4	35	B lighter. Some G.
4	45	G more extended, greater Satn.
5	18	Eyes feel bulging and big.
5	55	Faint spot of B.
6	00	Spot of B and some G.
6	05	G, high Satn.
6	10	YG.
6	20	YG getting thinner and thinner.
6	30	More background.
6	45	Faint spot of B.
7	00	B gone.
7	30	G and B faint but very pleasant, in the form of a straggling S.
7	55	G and B, but spotted.
8	00	G.
8	05	G moving (as often, the color sweeps over the field, then closes up in a bunch, and disappears as if going down a spout).
8	35	B, ultramarine, surprisingly beautiful.
9	10	B moving away.

[1] The following abbreviations are used: Red—R; Blue—B; Yellow—Y; Green—G; Purple—P; Violet—V; Saturation—Satn.

TIME. MIN.	SEC.	VISUAL PHENOMENA.
9	15	G very faint, appearing above the B.
9	30	G light with B around the edges.
9	40	Mere background.
9	50	G very faint.

These colors are constantly shifting. Some (G and B) are very pure, corresponding to the standard saturation, and always luminous. Y and R are conspicuously absent. Y is never seen, except as a tinge in YG. R is experienced very rarely in the form of heliotrope, though not reported in the particular series just given. Evidently the assimilative retinal processes strongly predominate. When "no color," or "mere background" is indicated, the visual field is not a dead black, but something which is always described as a "mottled, muddy background." If a color tone extends or contracts, its saturation varies inversely with its extent.

(2.) *Photisms: (a) with simple noise and tone.*[1]

Noises, such as a single tap on the table, cause either mere winking or a general disturbance in the visual field. The darkness expands in waves from the center, as the ripples of water about the place where a pebble has been dropped. This is usually termed a "feeling of visual struckness."

Single tuning-fork tones. The vibration rates from 40 to 56 were given by Appunn's wire forks, held close by the ear; the rates from 128 to 1,152 by a set of Koenig forks on resonance boxes; those from 2,048 to 32,768 (?) by Appunn's high forks, actuated by bowing. The subject usually got a settled photism only after the upper partials had died away. Unless otherwise characterized, the colors are as described

[1] In the following experiments the subject was blindfolded and seated facing the source of sound. When after-images had disappeared the stimulus was given, preceded by the usual 'ready' signal. The stimulus lasted (except for noise) about ten seconds; at the end of that time the blindfold was removed, and the subject gave a detailed introspective report, picking the associated color from the six plates of the Prang *Standard of Color* (Popular Edition, No. 1, Boston, 1898). Although these color plates are too 'dead' to give exact representations of the photisms, some such classified and readily accessible scheme of color was felt to be serviceable not only for the publication of results, but also for avoidance of the large error (mentioned by other writers) of mere verbal description. Plate I of the *Standard of Color* contains seven horizontal rows of 24 colors each. The upper row gives the 24 most saturated color tones, ranging from red (R) through orange (O), yellow (Y), green (G), blue (B), and violet (V), to the purples (V R V, R V and R R V). The intermediate tones are lettered by combinations: *e. g.*, very blue violet (B B V), blue violet (B V). Below this upper row there are six rows giving graded 'tints' of the saturated colors of the upper row, row six being palest. This scheme of Plate I is repeated over again in each of the six following plates (II-VII), except that the whole plate is successively dulled or "broken" by the addition of black. Plate VII is, therefore, the darkest.

above, cloudy diaphanous forms projected before the face. It will be noted that the noise of striking the Koenig forks gave a visual disturbance similar to that caused by tapping upon the table. The colors are quite spontaneous, and usually surprises to the subject. They have the brilliancy of transmitted light through colored gelatines, and not the deadness of reflected colors.

TABLE I.

Single Tuning Forks.

r.		COLOR.		INTROSPECTIVE REPORT.
NOTE.	VIB.	PLATE.	QUALITY.	
E_1	40	V.	B	Surprised. Aroused verbal "mosquito." Horrid tone. The blue gray went through my head from one ear to the other.
G_1	48	V.	YYO	
B_1	56	—	——	Movement in visual field. Tone unpleasant.
C	128	I.	G	A very pleasant, luminous green seen through black. Not like any 'material colors'. Only came after upper partials had died away.
c^1	256	I.	G BV	Striking caused a flash of brightness. Then a green veil spread for a moment over the whole field. Next a horizontal strip of B V which spread out and got thinner till the tone ceased. The tone was pleasant.
d^1	288	IV.	VRV	Lasted exactly as long as r.
e^1	320	—	——	Striking gave 'visual movement.' No color as tone was not specially pleasant; not big enough.
f^1	341.3	I.	G_4	As seen through black veil. Tone quite pleasant.
g^1	384	I.	B_2 BBG_4	
a^1	435	I.	GYG_8	Appeared with the tone, but persisted slightly after it had stopped.
b^1	480	—	——	'Struckness' only. No color as tone was somehow indifferent.
c^2	512	I.	G_5	
e^2	640	I.	RV R	These colors were not seen projected, but merely 'suggested.' R was nothing but verbal "red." Surprise at pitch of r being considerably higher.
e^2	640	I.	GYG_4	
g^2	768	I.	YYG_3	Color got clearer and more saturated as the tone cleared.
—	896	I.	BBG_6	
c^3	1012	I.	G_4	Very, very thin color.
d^3	1152	I.	VBV_2	Visual movement and a "suggestion" of the violet.
e^3	1280	I.	VRV_1	Striking caused a momentary flash of green, then the violet appeared in a wide horizontal band, which contracted and became more saturated as the tone cleared.
c^4	2048	I.	YYG_2	Sour, horrid, unpleasant tone and color.
g^4	3072	I.	B_2	Tone less unpleasant. Color fairly pleasant.
c^5	4096	I.	YYG_4 Y_4	YYG_4 seen through Y_4. Color unpleasant. YYG grits the teeth. Tone shrill and unpleasant.
g^5	6144	—	——	Tone very horrid.
c^7	16384	—	——	
g^7	24567	—	——	
c^8	32768	—	——	Chills.

(*b.*) *Fusions.* Table II gives the photisms resulting from various tuning-fork fusions. Many of the combinations were repeated at different points in the series, but are grouped together for convenience. It will be seen that there is very little constancy in the reactions, but this is to be expected in view of the emotional link which forms their basis.

TABLE II.

Tuning Fork Fusions.

r.	COLOR.		INTROSPECTIVE REPORT.
	PLATE.	QUALITY.	
c^1–c^2	—	——	'Struckness.' Opening of the darkness.
c^2–c^3	I.	GYG BBG	BBG seen behind GYG.
c^2–c^3	—	——	
c^1–e^1	—	——	Field got surprisingly and intensely black.
c^1–e^1	I.	GYG—G	Between the two. At the last began to get bluer.
c^1–f^1	—	——	Simple struckness.
c^1–f^1	I.	GYG—G	Between the two. A pleasant fusion.
c^1–g^1	I.	GYG_1	
c^1–g^1	I.	BBG_5	This was seen only with the left eye! Very unpleasant and quite unexpected to feel it so.
c^2–e^2	—	——	
c^2–e^2	IV.	BG_4	(Fusion given much more intensively.)
c^1–d^1	—	——	
c^3–e^3	—	——	

Table III gives the photisms resulting from the same fundamentals given simultaneously upon the piano. The experiment was intended to test the influence of the greater complexity of the resultant tone compound and of the piano 'color' upon the visualizations.

TABLE III.

Piano Compound Clangs.

r.	COLOR.		INTROSPECTIVE REPORT.
	PLATE.	QUALITY.	
c^1–c^2	—	——	Nothing at all.
c^2–c^3	—	——	Struck feeling only.
c^2–c^3	II.	B_6	And struck feeling also.
c^1–e^1	—	——	Struck feeling very plain. The visual 'opening' was complex as though several pebbles (three?) had been thrown into water.
c^1–e^1	I.	G_4	
c^1–f^1	III.	B_6	But even paler than this.
c^1–g^1	—	——	'Struckness'.
c^1–d^1	I.	GYG_4	'Struckness' followed by the color.
c^2–e^2	II.	B_6	
c^2–e^2	II.	GYG_6 B_6	Very indefinite.
c^3–e^3	—	——	'Struckness'. Rather unpleasant.
c^1–d^1	I.	GYG_4	'Struckness' followed by the color.
c^1–d^1	II.	B_5	Quite unpleasant.

Comparison of Tables II and III shows a tendency to less saturated colors with the piano clangs. No color in Table III is assigned a place above row 4 in the chart, and most belong to plates darker than Plate I. The piano clangs were not so pleasant as the tuning-fork fusions. That this difference is due to the piano timbre rather than to the more complex nature of the auditory stimulus is shown by Table IV.

(*c.*) *Church organ.* Through the kindness of Mr. G. M. Chadwick, the University organist, we were able to try the effect upon the pho-

tisms of the various pitches in the varied tonal colorings of the different organ stops. The colors thus seen are much richer and more abundant than those obtained either from piano notes or phonographic selections.

For the sake of uniformity the same chord c-e-g was played in every instance, and was held until the subject announced the photisms clearly set,—usually about 5 seconds. This series was taken under slight fatigue which, contrary to the opinion of Flournoy, hinders rather than favors the photisms.

TABLE IV.

Church Organ.

STOP.	LENGTH. FEET.	COLOR. PLATE.	COLOR. QUALITY.	INTROSPECTIVE REPORT.
Bourdon,	32	——	——	
Bourdon,	16	——	——	Movement of the background from left to right.
Open Diapason, Pedal,	16		VRV	Solid heavy color.
Violon,	16	I.	G_3	
Full Pedal A,	16	——	B	Went in waves. Pleasant at first.
Contra Gamba,	16	I.	BBG_2	
Gamba,	8	I.	G_4	
Open Diapason,	8	I.	YYG_3	
Melodia,	8	I.	BBG_1	Very pleasant tone and color.
Great Diapason,	8	I.	G_3	
Violina,	4	I.	YG_4	
Violina (Octave lower),	4	I.	GYG_1	
Octave (Principal),	4	I.	YYG_4	Color unpleasant. Tone too shrill.
Fifteenth,	2	I.	G	Shivering clouds of G. Very thin. Located in top of head.
Vox Celeste and Octave Coupler,	8	I.	VBV	Both color and tone very pleasant.
Vox Celeste, Coupler, Violina and Contra Gamba,	16, 8, & 4	I.	VRV	Very luminous.
Concert Flute,	8	I.	YYG_3	
Flute d'Amour,	4	I.	G_3	Luminous color. Very pleasant tone.
French Horn,	8	I.	BBG_1	
Oboe,	8	I.	V	In a horizontal streak. This often occurs with V.
Cornopean (Small Trumpet),	8	I.	YG_2	Not so pleasant as Oboe.
Clarinet,	8	I.	BBG_4	But 'sharper' than this color.
Contra Fagotta (Clarinet bass),	16	III.	ORO	
		II.	VBV	
Contra Fagotta (an octave lower),	16	—	——	Mere roughness.
Cor. Anglais,	8	I.	GYG_4	Very clear.
Trumpet,	8	I.	YYG_3	Not very pleasant tone or color.
Clarion,	4	I.	Y_5	Clearer tone than Trumpet.

Table IV shows that the photisms developed by organ tones are 'clearer' than piano photisms, but 'paler' than fork photisms.

(*d.*) *Successive fork tones.* In these experiments two or four forks were hit successively at intervals of about three seconds, and then the resulting fusion was allowed to run for ten seconds. Usually each tone (especially when two forks were used) aroused its own color; during the tonal fusion these colors would intermix (not fuse) like two paints

stirred together upon a palette. Table V contains the results. Where two tones and two colors are given the first color is to be assigned to the first tone.

TABLE V.

Successive Fork Tones.

TONES.	COLOR. PLATE.	COLOR. QUALITY.	INTROSPECTIVE REPORT.
c^1, c^2.	I.	YG_3 / BBG_2	During the fusion the two were intermingled yet each was distinct.
c^1, c^3.	I.	RV_3 / YYG_5	YYG_5 appeared and persisted much higher, spatially, than RV_3.
c^2, c^3.	I.	BBG_1 / G_4	Expected that the colors would fuse, but they did not, though less separate than in the preceding test.
c^1, e^1.	I.	— / RV_1 / YYG_6	The fusion was RV_1 seen through YYG_6. First note gave nothing. The second the RV_1.
c^2, e^2.	I.	YG_6 / B	Intermingled during fusion, but still distinct.
c^3, e^3.	I.	B	Very thin and faint. Came with 1st tone.
c^1, d^1.	III. / II.	YYO_1 / YYG_3	Intermingled, giving an unpleasant, muddy effect. Surprised at low tones.
c^1, f^1.	III. / II.	RRV / GBG_3	Colors more separate during tonal fusion than with the c–c or c–e fusions.
c^1, g^1.	I.	B_1 / G_5	
c^2, g^2.	I.	YG_5 / —	Nothing with the second tone, probably owing to lack of attention.
c^1, e^1, g^1, c^2.	I.	B_1	Blue appeared only when all had sounded. Surprised not to have other colors.
c^2. g^1, e^1, c^1.	I.	G_4 / B_1	G_4 came with the first tone. It changed to a very luminous B_1 when all had sounded.
c^1, f^1, a^1, c^2.	I.	GYG_4 / B	Whole chord gave bright B in the middle of GYG_4.
c^2, a^1, f^1, c^1.	I.	G_1 / B	Both thin and floating over the dark background.

(*e.*) *Continuous Tone Change.* This form of stimulus was supplied by Stern's blown bottle apparatus. The range was from 224 to 308 vibrations, *i. e.*, a movement of 84 vibrations, which was traversed in 42 seconds, or at the rate of 2 vibrations per second. This experience was rather unpleasant to *M*, and the induced colors were correspondingly rare, and when present usually of an unpleasant yellow-green quality.

Moving up produced in the first test B G, which changed to G B G, and finally to G Y G. This test was fairly pleasant. A second test gave no color at all; a third induced, only near the close, Y Y G_2 modulating into a faint Y_3.

Moving down produced in the first test, at the start, no color; then Y Y G, and finally Y G. It was quite unpleasant. The second test started at Y_2, which faded into black. Next Y G_3 appeared, and faded into black, and finally B G_2 came.

(*f.*) *Intensity.* As to the effect of intensive variations upon the subject's photisms, it was found by general observation that on the whole greater intensities produced more saturated and more luminous, but rarely, if ever, more extended colors. Specific tests were made with

the f[1] tuning-fork. It was struck by a wadded hammer, and the tone allowed to die away. It aroused a very luminous strip of violet, which became more saturated and brighter as the tone cleared. The dying away of the intensity from this optimal point, at which the partials have just ceased, was correlated with a spreading and thinning of the photism. In a second test the fork was suddenly brought close to the ear when it had nearly died away. The photism and its changes were exactly like those of the first test, except that the sudden intensification increased the saturation without altering the extent of the violet. A third test, exactly like the second, induced a yellow-green light which behaved in similar manner to the violet of the second test.

(*g*.) *Musical Selections.* These were given upon the piano, the phonograph and the church organ, under essentially the same conditions as the preceding tests. As would be expected, the induced visualizations were more complicated and more irregular than those experienced with single tones or chords. The church organ aroused richer colors than the phonograph, when the same selections were heard on each during the same hour; but the phonograph, when removed from this 'dulling' effect of contrast, afforded as rich and pleasing colors as the organ: everything depended upon the emotional effect at the time. All the phonograph selections were repeated at intervals from a few seconds to several months. The results of immediate repetition are as likely to be divergent as those of repetition after the lapse of a considerable time.

1. *Piano.* "The Two Roses" played in the key of a (220 vibs.), gave Plate VI, R R V, vertically on the right side of the field of regard, and Plate VI, B on the left side. At the highest point reached by the melody, there arose Plate II, O Y O_4.

The same selection, played one octave higher (a-440 vibs.), was less pleasant; it gave as photisms Plate IV, B_4 in moving clouds, and some Plate IV, G_3, which slowly came and went.

2. *Phonograph.*

1. *Bridal March from Lohengrin* (brass band). The notes seemed to be separately visualized, each instrument being represented by countless little light points which moved in and out with their rhythm. Later, some Plate I, G and B appeared, which also fluctuated with the time.

The same selection, repeated five weeks later, gave indefinite and grayish colors, Plate III, G_2, B_2, and R_3. A tremolo effect roughened the colors. The horns aroused Plate I, Y Y G_2 and Y G, colors which seemed bitter to the subject.

The same selection, a few minutes after it had been heard on the church organ,[1] gave Plate I, Y G and B, not very pretty, unsteady, and spotted with black.

2. *Intermezzo from Cavalleria Rusticana* (orchestra), a very highly pleasing selection, gave extremely vivid and complex colors, all in Plate I. At first there was a very solid G, shifting to B, in which there were occasional flashing specks of O. These colors were in the upper visual field. Toward the end, where the trombone bass was prominent,

[1] See below, p. 388.

there appeared a very rich R R V or R V in the lower visual field. The high repeated attacks of the violins in this part gave B_3. The visual experience was very pleasant, but the auditory more so.

Five weeks later the same piece aroused Y^1 with the violin passage of the introduction, immediately succeeded by B and G and some Y_3. At the end R R V_2 appeared below the others, as in the first experience. After listening to it on the church organ, the *Intermezzo* on the phonograph gave G, B, Y (with the high violin passage) and V B V (with the trombones).

3. *Pilgrim Chorus* (band) induced R_4 for a short time, also R R V_4, B B G_4, G_3 and Y_4 (with a high note). These colors were less vivid than those aroused by the *Intermezzo*, more vivid than those of the *Bridal March*, but not especially pleasant to see.

Four weeks later it induced G, Y G_2, R R V_3, and B_2 on Plate I; B_1, B G_2, R R V_2, and O_2 on Plate III. The higher notes aroused colors higher in the visual field, together with eye strains of glancing upward. The trombones and bass horns aroused the R R V photisms. After the church organ the *Chorus* gave Y_1, R V_1, G Y $G_{1, 2, 3}$, and B B $G_{1, 2, 3}$.

4. *March from Carmen* (orchestra). A very vivid G appeared with the sound of the cornet and piccolo, and vibrated when they played a rapid staccato time; with other instruments (perhaps strings) appeared Plate II, R V_3, and jumping splashes or spots of Plate II, Y_2.

A few weeks later the subject experienced with this march a sudden flashing of the colors, chiefly G, at the first sound of the music. Throughout the selection, which is very exhilarating and accentuated in character, the whole visual field vibrated with the music, even the background taking up the movement when the colors were faint. The color-clouds were Plate IV, G, B, and B_1, and Plate III, G_1. Once there appeared a rainbow effect,—straight bands of R, G and B stretching across the field.

After the church organ *Carmen* occasioned merely faint greens and blues. An accidental pinching of the rubber ear-tube during the experiment brought about a sudden closure of the visual field and total disappearance of the photisms.

5. *Yankee Doodle* (banjo with piano accompaniment) produced dull, 'dead,' solid colors, a sort of background,—and not at all pretty. These colors were dark greens, blues, and yellows, which kept beating in the background with the twanging of the banjo, like little hammers hitting against the field.

This general setting was repeated in the photisms for the same selection a few weeks later. At the sudden loud start *M* winked, and the visual background jumped and stirred. The colors were at first indefinite, but throbbing distinctly in time with the banjo. Then they became more intense, taking on a striped appearance instead of the usual vaporous clouds. There were about six stripes of alternating Plate IV, R_3 and Plate IV, B_1. When the piano took up the melody it appeared visually as Plate II, Y Y O_2.

6. *I Fear No Foe* (bass solo with piano accompaniment). This song was distasteful to *M* because she did not like the voice of the singer. The colors were dull, rough and dead, like those of Plate VI of the Color Standard. The lowest note reached gave R R V of Plate VI.

The second hearing furnishes a good illustration of the emotional type of associative supplementing. While the colors obtained vary radically from the above they are still faint, dull and unpleasant. They were G Y G_3 and G B G_4. The very low note this time induced a thin green overlaid with an unpleasant brown.

[1] When no plate number is assigned Plate I is to be understood.

7. *Sally In Our Alley* (tenor solo with piano accompaniment) was pleasanter than the bass solo. It occasioned G Y G_3, G_4, G B G_3 and B_6. The turns produced a visual figure like a twice coiled spring.

8. *Grand March from Tannhäuser* (band) was, except in the fatigue test to be mentioned later, tried only after it had just been heard on the organ. On the phonograph it gave B, G, R R V, and flashes of brightness.

2 a. *Projection Experiments—Phonograph.* These tests differed from the preceding in that the eyes were open and looking, though without steady fixation, at a large black or colored screen hung about 20 cm. before the face.

I. *Black Screen.* Simply staring at the black screen for a length of time equal to that consumed by the musical selections gave Plate II G_3 (trembling like a drop of water), Plate I G Y G_4 (in a band) and Plate I B_4 (in the upper part of the field). These colors were all exceedingly faint and distinctly different from those projected by the music.

The *Bridal March* caused suffusion of the dead black with the following colors: R V_2, R V_3, V B V_2, B_4, and G Y G_4. They were not so strong as those seen with closed and bandaged eyes, and constantly changed. The reddish violet appeared in the form of a half-arch, about 15 cm. high, leaning over to the right.

II. *Red Screen.* Without the music no other colors appeared on the screen.

The *March from Carmen* induced photisms described as very thin veils through which the strong red background could always be seen. Y was quite frequent; a rather stronger B less frequent. This B made the area of the red on which it was projected appear V B, but the two colors were analyzable into the red background and the blue "veil." There was an occasional green. The B came with the horns and lower passages; the G and the Y with the higher passages.

III. *Green Screen. Grand March from Tannhäuser.* The principal veiling was yellow. A particular feature of the music induced a blue, which at one place narrowed into a small but quite thick and satured strip.

Green alone was seen without auditory stimulation.

IV. *Yellow Screen. Intermezzo from Cavalleria Rusticana.* The only projection observed was a faint horizontal blue strip which was correlated with the trombone, and which descended step by step down the screen with the descending trombone passages. Without music there were no projections.

V. *Blue Screen.* The *Intermezzo* repeated here caused a great deal of green, a single fleeting dirty yellow, and again a descending photism correlated with the trombones. This was a blue-violet effect, during which the blue background lost nearly all its saturation. Here, also, auditory stimulation was required to produce projected colorings on the background.

3. *Church Organ.* These selections comprised a repetition of the

principal phonograph pieces and, in addition, three pieces which had aroused photisms for *M* during organ recitals given by Mr. Chadwick.

A slight fatigue on the day selected for the experiment somewhat reduced the brilliancy of the photisms. They were, however, as already pointed out, more brilliant than those aroused by the same selections on the phonograph during the same hour.

Handel's Largo, the first of the extra pieces, was rendered with diapason and melodia stops in the introduction, and with melodia, concert flute and small diapason as the solo stop. The introduction was seen as G B G, B B G, and V B V arranged above one another in horizontal bands, the solo stop as Y G. Besides this, V and V R persisted throughout. Both the music and the colors were 'sweet' and very pleasant.

A *Chorale* was next tried, with a 'round'[1] stop setting, with later a sudden addition of reeds and mixtures[2]. The round stops induced blue; the addition changed this to green. The same selection was repeated, except that the full organ was added. This addition occasioned a burst of vivid green.

Chopin's Funeral March was colored Y G. Here again the sudden addition of the full organ was correlated with a luminous green, which burst close to the eyes.

The effect of the rendition of the standard phonograph music upon the church organ is given in Table VI. These photisms may be compared with those already mentioned as occasioned by the phonograph during the same hour.

TABLE VI.

Church Organ.

SELECTION.	COLORS AND INTROSPECTION.
Pilgrim Chorus,	With the violins a very luminous BBG_2; with full orchestra effect YG over RV. At other times B and G.
Grand March,	Mostly VRV_1 and G. Also G_1, G_2, G_3, and B_4. All the colors thin.
Intermezzo.	VRV, V, G, and a very high, pretty and luminous B_3. The colors all shivered and trembled (owing to the influence of the Vox Celeste and Tremolo stops).
Bridal March,	A predominance of blues, and also RV_2, VRV, G, and YG.

(*h.*) *Centrally Excited Photisms.* Several deliberate attempts were made to induce photisms from centrally excited melodies. Although the process of imaging the music was pleasant, no photisms could be secured. The pieces attempted included popular airs and some of the phonographic selections used in the previous experiments. Careful observation also has failed to disclose any colorings in centrally excited music at any time in the subject's life.

(*i.*) *Fatigue.*[3] Other authors have asserted that fatigue tends to pro-

[1] *I. e.*, melodia, flutes, etc.
[2] Full swell organ, coupled with octaves.
[3] These results were so constant that details may be omitted.

duce greater frequency and brilliancy in synæsthetic phenomena. In order to test this a successive fork series and four phonograph selections were given to the subject when she was in a state of considerable fatigue. The results showed that the music was then soothing and restful rather than exhilarating in character. The photisms were *not quite so frequent*, and though pleasant were almost invariably *much paler*, corresponding to the 3rd, 4th or 5th rows of the Color Standard plates.

(3.) *Photisms with other Senses. Taste and Smell.*

Before these tests the subject had never experienced colored taste or colored smell, and felt confident that no colors would be aroused. The results showed, however, that both these photisms were present, though in much less developed form than the others. The colors were always rather slow to appear and were flatter, deader, more like reflected light, than those with sound.

(*a.*) *Taste.* The results with tastes tried upon two occasions nearly a year apart, are not very concordant. Certain features of them will be found, however, to exhibit very close similarity with the taste-colors of Case II, later to be mentioned. The solutions were sugar 20%, salt 2%, tartaric acid .5%, quinine (hydrochlorate) .2%. Enough of each solution was taken to cover the whole tongue.

The following results were obtained in the several trials:

Sweet. (1.) No color. Taste was pleasant at first then sickening.
(2.) No color. Taste not recognized at first. Called up verbal "cool" and "high."
(3.) GYG_3, B_2, and GBG_2. The first was a line only; it spread out, growing bluish. The taste was not very pleasant.

Acid. (1.) YYG_2. Shivered, drew up whole body. Mouth puckered. A clean taste.
(2.) YYG_2 and associated visualization of some green grapes picked in childhood.

Salt. (1.) No color. Very unpleasant.
(2.) BBG. Taste quite weak.

Bitter. (1.) O_2. Over a blackish background.
(2.) YG_3. Tastes like some kind of medicine.

Sweet and Acid. BBG_4. This color was not projected at all, and was rather a 'suggested' color.

(*b.*) *Smell.* Although the subject's sensitivity for odors is quite poor, colors were very certainly incited by smell stimuli. They appeared at about the second inhalation, and lasted till the stimulus was removed. The following results were taken one week apart, each odor thus being twice tested.

1. *Wormwood.* (1.) Very faint red. Vague visualization also of a flower.
(2.) Yellowish green. Neither odor nor color pleasant. Visualization of a brook and dusty green peppermint growing beside it.
2. *Cinnamon.* (1.) Very faint green. Smell seemed cool at first, then warmer.
(2.) Warm blue. Smell was pleasant and warm.
3. *Asafœtida.* (1.) No color. A clean 'hospital' smell. Visualization of rows of beds.
(2.) No color. A cold smell. Same 'hospital' complex plus a doctor with gray hair.
4. *Anise.* (1.) Faint reddish-violet. Quite pleasant.
(2.) Green. And then a visualization of green pickles, also a store, and a woman by the pickle barrel (a childhood scene). Pleasant but funny smell.
5. *Camphor.* (1.) Ice green photism, and visual and auditory "camphor."
(2.) Faint but pretty pearl gray, and later saw a dentist. The dentist was unpleasant, but the smell was clean and pleasant.

6. *Crab Apple Blossom.* (1.) Small faint green photism. Then a visualized candy store of childhood.
(2.) Very faint green, undulating and pleasant. Visualization, a scene from a book she had been reading of a room in a country house, all hung in white—muslin curtains blowing in the breeze and lilacs upon the table.
7. *Bisulphide of Carbon.* (1.) Dark orange brown with light gray in it. Very unpleasant.
(2.) Sickly orange yellow. "Very horrible" color and smell.
8. *Wood Alcohol.* (1.) No color. Visualization, a physician. Smell was at first sniff unpleasant, then became pleasant.
(2.) Green. Pleasant. It has some very strong association, but can't get at it.
9. *Rose.* (1.) No color. Odor very faint and cool. Visualization, a garden with shady green walks.
(2.) No color. The smell was unknown. Very pleasant. It aroused a verbal "choir invisible" and a visualization of the dainty lady who was like "Rosemary and faded rose leaves, between the sheets of old music."

(4.) *Miscellaneous Synæsthetic Phenomena.*[1]

M has no phonisms, and no visual forms for numbers, days, months, etc. She visualizes additions, multiplications, etc., only as numerals. The only other phenomena analogous to those described are the personifications given to numerals, letters, and inanimate objects, and the converse tendency to see resemblances between persons and other things animate and inanimate. Thus, for example, one person appeals to *M* as a log of wood, another as a toad, a third as a mosquito, a fourth as a walrus.

Personified numbers and letters are not usually visualized as persons, but endowed with human characteristics. In childhood, 7 was unpleasant, cross, always fighting with 8. The two were, unfortunately, too close together. 5 is a pleasant number, 3 very unpleasant.

There remains to be mentioned the coloring of words and individual letters. Excepting the auditory word "horn," which is orange yellow from the color of brass instruments, and an occasional associative supplementing of especially affectively toned christian names—such as Bernice,—blue,—the subject never has photisms with words.

Individual letters are never heard or seen as colored. The following list contains a list of colors which seemed to the subject what they *ought to be* and *must be*, if they have any color at all. On the other hand, the affective tones and the personal characteristics of the letters are quite real, and in some cases very vivid and decided. The entire alphabet was canvassed twice. The second time was nearly a year after the first, so that it is but natural that many of the reactions differ. In fact they might, according to the subject, be different from day to

[1] Many writers have pointed out that colored hearing is often associated with number forms, personifications, etc. Flournoy, *op. cit.*, p. 14. Calkin's, Experimental Psychology, at Wellesley College. This *Journal*, V, p. 260.

day. In general, *M* visualized a printed capital letter, and then thought for 10 or 15 seconds before announcing the report, in order to feel herself just like the letter in question.

TABLE VII.

Alphabet.

TER. LET-	AFFECTIVE TONE.	COLOR.	OTHER CHARACTERISTICS.
A	Pleasant,	Red,	
A	"	———	
B	Less pleasant,	Blue,	
B	Neutral,	Blue,	Fat.
C	Unpleasant,	Greenish yellow,	
C	Very pleasant,	Green,	Good natured.
D	Unpleasant,	Brown,	Stupid.
D	———	———	Nice, happy, jolly, fatter than B. A man with red cheeks, bright eyes, hopping around with his hands in his pockets.
E	Pleasant,	Reddish,	
E	Neutral,	———	
F	Unpleasant,	Green,	
F	———	———	Rough. A log of wood.
G	———	Dull bluish green,	
G	———	———	Unhealthy.
H	Pleasant,	Something rich,	The width is pleasant.
H	———	———	Feels aristocratic but is n't.
I	Less pleasant,	Thin yellow,	Thin.
I	———	———	Like Uriah Heep.
J	Unpleasant,	Yellow green,	Ugly.
J	"	" "	Not nice. I don't like it. Never have much.
K	———	Cold blue,	Hard (sound).
K	———	———	Has been an outsider in the letters, but is now trying to get along with them.
L	Pleasant,	Reddish,	But less than A.
L	"	Blue,	Refined, quite nice. A very elegant person.
M	Very pleasant,	Violet,	Liked because it is my initial.
M	———	———	" " " " " Quite nice.
N	Pleasant,	Bluish,	
N	"	———	Agreeable.
O	"	Something rich and extended,	Generous.
O	"	Yellow,	Jolly and full of fun.
P	———	Green and dirty brown,	Mean, selfish.
P	———	———	Dignified and a little conservative. [rano.
Q	Pleasant,	———	Bizarre. Fine qualities under it. Like Cy-
Q	———	Yellow green,	A genius. Erratic and unusual.
R	Pleasant,	Rich green,	
R	———	———	Ordinary. Not neat. Like a woman who dresses in second-class style, but puts on the airs of the first-class.
U	———	———	Disappointing. Attempts to be a beautiful red, but falls short of it. [natured.
U	———	Orange (?),	Happy. Stout, but not like D, not so good
V	———	Dark gray,	Dignified.
V	———	Delicate blue,	Aristocratic. Very dignified and feminine.
W	Pleasant,	Red and purple,	Jolly. "Hail fellow well met." [thrift.
W	———	———	Generous. Good hearted, and yet a spend-
X	Unpleasant,	Green,	[to be one.
X	———	Rough blue,	Like an ordinary working man who tries not
Y	———	Dark gray,	Dignified.
Y	Pleasant,	Blue,	Like music.
Z	"	Yellow and green,	
Z	———	———	

For further general remarks upon Case I, see the final résumé.

Case II.

§ 1. *Historical.*

The subject of the second case is *R.* (Mr. E. C. Roberts), an undergraduate student of the arts department. *R's* father is musical. He himself is fond of music, and both plays and sings. At the age of 15, he read an article on Colored Hearing in a paper, and then noted that he had associations of color with tones, tastes, and temperatures.[1] In spite of discouragement from members of his family he continued to observe the photisms, and found a good deal of pleasure in determining the correlations. At the same period he noted phonisms of pain. These, however, were not prominent until the summer of 1899, when a badly injured finger gave occasion for a series of determinations of the 'pitch' of the pain. *R's* colors differ radically from *M's*. They are but rarely vivid enough to be projected,[2] yet they are very detailed and very constant. *R* uses the word "match" to describe the relations of the correlated sensations.[3] That the color is, however, consciously present, and not a mere verbal association, is evinced by the discriminating manner in which *R* chooses the color tone from the Prang plates, and further by the fact that in the process of 'matching' a certain color tone and only one in the chart 'affects' him just as the sound did. Despite the use of this word, the link which forms the basis of *R's* synæsthesia does not seem to be an *affective* link. As a rule, the whole process is indifferent.

§ 2. *Experimental.*

The following tests, with the exception of the Galton whistle and of the experiments upon phonisms, are duplicates of those already mentioned.

(1.) *Retinal Colors.* The following list shows that the dark-room visual phenomena of *R* are essentially similar to those of *M.* The 'nothing' reports indicate merely absence of coloring; the field during these periods is generally disturbed by spots, lines, and mottlings of gray. The "dull blue" is Plate VI, BBV, the dull green Plate IV, YYG, the bright blue a luminous Plate III, B.

TIME.		VISUAL PHENOMENA.
M.	S.	
0	0	Muddy G.
0	20	Dark B.
2	45	Dull G.

[1] The plunging of the hands into cold water, *e. g.*, was always 'red.'

[2] All colors which are projected are indicated in the Tables by an exclamation point.

[3] Oddly enough, both types may be present, and the colors projected may be dissimilar to those which would be 'matched' or 'assigned' to the stimulus. See Table IX, Second Test.

TIME.		VISUAL PHENOMENA.
M.	S.	
3	00	Dull B.
3	15	Nothing.
4	00	Faint brightness.
4	35	Very dull B.
5	00	Gray and G. Well defined patterns.
5	20	Brighter gray.
5	50	Nothing.
6	18	Dull B.
6	40	Nothing.
7	00	Dull B.
7	08	Dull G.
7	24	Brighter B.
7	53	Very bright B. } Uniformly spread and fringed with a zig-
8	10	Exceeding bright B. } zag green border.[1]
8	20	B.
8	45	Nothing.
9	35	Dull B.
9	55	Brighter B.
10	20	Momentary spots of very bright B.
11	50	Bright B.
11	55	Bright B in a cloud with a green border.
12	05	Bright G.
12	08	B.
12	20	G. Cloud spread over the B.
12	32	A succession of these colored clouds of different shapes.
13	08	Bright B spots on B ground.
13	45	Flash of G over the B ground.
14	10	B ground changed to black.
15	00	All black with one or two bright spots.

(2.) *Photisms: (a) with Simple Noise and Tone.*

Noises. A sharp rap on a table aroused a faint but distinct narrow flash of brightness, running from left to right across the field.

Single tuning-fork tones. One complete and one partial series are represented in Table VIII. The duplicate members were retaken after one month to test the constancy of the association. The prevalence of R and V—colors absent from the retinal lights—is noteworthy.

Tests with the Galton whistle gave a brightness streak, the inclination of which varied with the intensity of the whistle. Another series produced nothing but unpleasantness.

(*b.*) *Fusions.* Table IX gives the results of tests for the photisms of tuning-fork fusions. We were unfortunately not able to use the Prang chart for this particular series.

(*c.*) *Church Organ.* The test for stop effects gave with *R* the results in Table X. With a single exception these colors were matches. The rather light-gray tones assigned to the 32 and 16-foot stops is of interest in contrast to the idea generally prevalent that very low tones should be dark.[2] The clarion stop, which at the pitch used (circa 512 vibs.) gave G, turned through red to a brown-gray when the pitch was successively lowered by octaves. Neither *R* nor *M* shows any definite correlation of color and tonal register.

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[1] A phenomenon of this sort is often seen (!) with organ music.
[2] Stumpf, *Tonpsychologie*, II, 526, 531.

TABLE VIII.

Single Tuning Forks.

r.		COLOR.		INTROSPECTIVE REPORT.
NOTE.	VIB.	PLATE.	QUALITY.	
E_1	40	II.	Y_5	Light copper color. Rather uncertain.
B_1	56	—	——	
c	128	I.	RO / RRV_5	Changed to RRV_5 as the fork died out.
c^1	256	I.	RRV_6	
c^1	256	—	——	A dull gray.
d^1	288	I.	V_4	
e^1	320	I.	RV_2	
e^1	320	—	——	A dull red.
f^1	341.3	I.	RRV	
f^1	341.3	II.	R_4	
g^1	384	I.	RRV_1	
g^1	384	I.	RV	
a^1	435	I.	R	
a^1	435	I.	RV	
b^1	480	II.	R	
c^2	512	I.	RV	
c^2	512	I.	BV	
e^2	640	I.	VRV	
e^2	640	I.	BV	Quite bright. Saw a little cloud of white light go across the field when the fork was struck.
g^2	768	I.	V	
g^2	768	I.	B	
c^3	1012	I.	VBV	
c^3	1012	I.	B	B shading into G.
d^3	1152	I.	VBV	
d^3	1152	I.	B	Very clear B.
e^3	1280	I.	V	Very bright.
e^3	1280	I.	BV	
c^4	2048	I.	BG	
g^4	3072	I.	GBG (!)	Surprised actually to see this color.
c^5	4096	—	——	
g^5	6144	I.	VG_4 (!)	In splashes upon a dark background.
c^6	8192	V.	G_4	

TABLE IX.

Tuning Fork Fusions.

r.	INTROSPECTIVE REPORT.
c^1–c^2	Between reddish brown and coffee color.
c^1–d^1	Bright red gray, but also saw (!) little rapidly vibrating spots of light, mostly blue, which vibrated with the beating of the forks and described forms like Lissajou's figures.
c^1–e^1	Dull red.
e^1–f^1	Dull red.
c^1–g^1	Matches reddish gray, but also saw (!) a pale cloud of yellowish green. The two felt incongruous.
c^1–a^1	Rather bright pleasant red gray.
d^1–g^1	A pale red violet with gray. At the striking of the forks saw (!) little clouds of bright blue.
c^2–e^2	Bright blue-violet.
c^2–c^3	Pure violet.
c^3–d^3	Matches RV, but saw (!) an indefinite disturbance in the visual field.
c^2–g^2	RV not so bright as the preceding.
c^3–e^3	(e^3 struck slightly first.) With the first, saw (!) clouds of bright blue, with the second a cloud of greenish yellow. The two clouds remained distinct and appeared alternately.

TABLE X.

Church Organ.

STOP.	LENGTH.	COLOR.		INTROSPECTIVE REPORT.
		PLATE.	QUALITY.	
Bourdon,	32	VI.	R_4	
Bourdon,	16	VI.	R_6	
Open Diapason (Pedal),	16	II.	YO_6	
Violon,	16	—	—	Medium gray.
Full Pedal,	16	V.	RRO_5	
Contra Gamba,	16	I.	V_6	
Open Diapason,	8	II.	RO_1	
Melodia,	8	I.	RV	
Great Diapason,	8	I.	RRV	
Violina,	4	I.	BG	
Violina (octave lower),	4	I.	GBG_3	
Octave,	4	I.	R	
Fifteenth,	2	I.	G	Very solid G.
Vox Celeste and Octave Coupler,	8	III.	R_3	Muddy.
Vox Celeste, Coupler, Violina and Contra Gamba,	16, 8, & 4	III.	R	
Flute d'Amour,	4	I.	BV	Bright.
Concert Flute,	8	II.	RRO	
French Horn,	8	I.	G_2	
Oboe,	8	II.	R_1	
Cornopean,	8	I.	R	
Clarinet,	8	I.	R_2	
Contra Fagotta,	16	II.	RO	
Contra Fagotta (octave lower),	16	IV.	RO_4	
Cor. Anglais,	8	II.	R_1	
Trumpet,	8	II.	RRO_1	Saw (!) green spots.
Clarion,	4	I.	G	

(*d.*) *Successive Tones* (tuning forks). Table XI shows *R's* coloring for successive tone complexes of three and four constituents. No pairs were tried. This form of stimulus was found to be decidedly pleasant; a fact which possibly accounts for the projected photisms in three out of the eight cases. All the colors are found in Plate III.

TABLE XI.

Successive Fork Tones.

r.	COLOR.		INTROSPECTIVE REPORT.
	PLATE.	QUALITY.	
c^1. e^1, g^1, c^2.	III.	VBV	This was the color of the whole complex.
c^1, g^1, a^1, c^2.	III.	VBV	" " " " " " " "
d^1, g^1, b^1.	III.	RV, R_1	b^1 was RV; the whole R_1.
b^1, g^1, d^1.	III.	BG, BV	All seen (!) in the lower right hand corner. The fork is always 'placed' visually in the center of the field. (These tones were given rapidly and quite intensively.)
b^1, g^1, d^1.	III.	BG, BV	The same projected visualization. (The tones were given less rapidly and less intensively.)
c^2, g^1, e^1, c^1.	I., III.	VRV, RO	c^2 was RO, the complex VRV.
c^2, a^1, f^1, c^1.	III.	BG, BV	f^1 was BG, c^1 was BV, both were seen (!). These colors coincided spatially with the 'placing' of the fork. Each fork when struck makes a flash in the field.

(*e.*) *Continuous Tone Change.* A steady tone of 224 vibrations was denominated Plate V, O_6, one of 308 vibrations, Plate II, V_4.

As the tone moved down from 308 to 224 vibs. the violet gradually shifted. First the blue faded out; then the red which remained became lighter and grayer till it reached the Plate V, O_6. *R* thought that if the tone had gone considerably lower it would have become clear white.

The moving up of the tone produced an exactly reverse effect, except that the entrance of the blue which carried the red over into violet was quite sudden. None of these colors were projected. This test well illustrates the greater uniformity of the photisms of Case II, as compared with Case I.

(*f.*) *Intensity.* The variation of *R's* colored hearing with the intensity of the Galton whistle has already been noted. The outcome of the other tests, with the f^1 tuning-fork, was quite dissimilar to that with *M.* A moderate intensity aroused (!) Plate III, B G_3; a weak intensity gave a brighter and smaller photism; and a strong intensity a more extended one. Silence is white.

(*g.*) *Musical Selections.*

1. *Piano.* The same tests were employed as with *M.* At the lower pitch *R* saw (!) red and green bands (Plate V, Y G and R R_0) at an angle of 60°. They appeared almost with the first note, and varied with the intensity of the music. At one place the angle of inclination changed slightly. At the higher pitch the same colors were seen (!), but in narrower bands and in a more vertical position.[1]

2. *Phonograph.* The musical selections upon the phonograph were at first quite unpleasant (owing to scraping sounds, and emphasis of partial tones), but after four or five selections, this affective reaction passed away.

(*a.*) *Bridal March* (1). No colors seen (!). Unpleasant. The prevailing color matches reddish brown (Plate III, RO), with green for the trombones.

(2.) Saw (!) a tube with flaring mouth sending out puffs of "music smoke" with the rhythm of the music. The 'matched' color for the whole selection is still a reddish brown, though clearer than before. (Plate II, RRO.) The music much less unpleasant.

(3.) Immediately after it had been heard upon the church organ,[2] the Bridal March occasioned no visualization, and matched Plate I, R. except the high violin part, which was RRV.

b. Intermezzo. (1) No colors seen (!). The color was bright red,

(2.) After the organ: matched RV with high violins B.

c. Pilgrim Chorus. (1) Slightly unpleasant, no association.

(2.) After the organ: saw (!) stripes of Plate III, R and Plate IV, G, arranged either in parallel oblique bands or in concentric arches piled one on another.

d. March from Carmen. (1) The whole selection matched Plate II, R. The flutes were of a very bright red.

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[1] This is a good instance of a feature of *R's projected* photisms. They tend to appear not as clouds or veils (as in *M's* case), but in rather detailed and specific forms, *e.g.*, as puffs of color from a 'tube' of definite size and inclination.

[2] See below, p. 397.

(2.) After the organ: the subject had the tubular visualization above mentioned, save that the faster time produced a narrower tube. Besides this he saw (!) one spurt of R, and G stripes, in the lower visual field.

e. Grand March. (1) This march aroused the same phenomenon as the Bridal March (2) and the Carmen March (2). Here the emitted 'puffs' became narrower and longer where the music was higher. The prevailing volume of the puffs, and hence the size of the tube, was in this march midway between the same dimensions in the other two instances.

(2.) After the organ: 'matched' Plate I, R.

f. Marble Halls (song from the Bohemian Girl, with piano accompaniment). The piano interludes were a bright violet, the singer's voice a very bright green.

g. Yankee Doodle matched Plate II, RRO.

h. I Fear no Foe was generally Plate III, G. The deepest notes of the singer's voice were YG of the same Plate.

i. Sally in Our Alley, a tenor solo, was assigned a brighter green (Plate I, YG).

3. *Church Organ.*

These tests included only four of the standard phonograph pieces. They are significant in comparison with the phonograph renderings heard during the same hour. The greater wealth and intensity of the church organ aroused actual projections of specific form, which are in marked contrast to the general sterility of the phonograph visualizations.

(1.) *Pilgrim Chorus.* This matched Plate II, VRVY. During the orchestral passage of descending 16th notes, the subject saw dropping rain. The violin and horn stops excited projections of broad B and narrow RRV stripes running obliquely upwards from left to right, the violin and fagotta stops similar projections running obliquely downward from left to right.

2. *Grand March.* Here R saw (!) concentric red and blue arches, and towards the close the phenomenon of smoky rings of brightness running up a tube in tune to the music.

3. *Intermezzo.* This was assigned a match,—horizontal strata of red and violet. There was no projection.

4. *Bridal March.* Again the 'puffing' visualization (!) was called forth. The 'angle' of the 'horn,' as in the piano selections, approached the vertical with the higher pitches. Finally a very high note made the 'horn' disappear in a momentary burst of colors (B, V, and Y).

(*h.*) *Centrally Excited Sensations.* In marked contrast to Case I is *R's* ability to obtain what he calls 'matches' from centrally excited sensations. An imagined sweet is as blue as the actual taste. His phonisms are likewise centrally excitable. Indeed, when he tried to rethink the pain of the injured thumb above cited, he found its 'pitch' much more available than its ache. After a few seconds' trial at the piano, *R* announced that this pitch was the discord of d^2 and e^2 simultaneously and faintly sounded.[1]

(*i.*) *Fatigue.* No laboratory tests upon the dependency of *R's* synæsthesia upon bodily fatigue were undertaken. He himself thinks,

[1] The reliability of this rather astonishing phenomenon is attested by the fact that *R* had picked out the pain of this injury several months before the above test was taken as starting out at a^2, and descending to d^2 as the pain lessened. He had forgotten the first test completely when the second took place. He does not know the piano keys by name

with *M*, that fatigue rather hinders than favors these experiences. Thus sleepiness prevented him from getting any colors at a certain organ recital at which he was anxious to observe colored hearing.

(3.) *Photisms with other Senses.*

(*a.*) *Smell.* *R* found few projected colors, when stimulated by odors, and the assignment of colors to smells was less natural, less spontaneous, than to tones. Especially, he often debated whether the color should be red or green. On the first day's trial, *R* suffered from a bad cold, and the stimuli were given in small bottles. The odors were thus in many cases too weak. On the second trial, the fluids were poured out into flat trays. The increased intensity sufficed to afford the following results.

TABLE XII.

Odors.

ODOR.	ASSIGNED COLOR.	SEEN COLOR.	FURTHER INTROSPECTION.
Camphor,	YG	——	Pleasant odor. Color doubtful.
White Rose,	RV	——	Very pleasant.
Carbon Bisulphide,	Dirty O	——	Unpleasant. "Take it away."
Crab Apple Blossom,	Clear Red Gray	Plate I. B	Very pleasant. The bright blue seen (!) was in the form of little lights, and was due to the odor. They were more pleasant than the "nice red gray" assigned, yet the "red gray idea" corresponds to "that odor idea."
Cinnamon,	——	Brightness,	A light cloud rising in the lower part of the field. "Sunrise on a small scale."
Anise,	R	——	Fairly pleasant.
Asafœtida,	B	——	Pleasant. Doubtful assignment,
Orange,	Deep R	——	Pleasant.
Peppermint,	RV	——	Pleasant.
Cloves,	RO	——	"Associated roast beef for some reason."
Oil of Citronella,	Deep unpleasant R,	——	Odor unpleasant.

(*b.*) *Taste.* *R* has always had colored taste along with his colored hearing. The laboratory tests were confined to the four standard solutions employed in Case I. The assignment of colors was subjectively considerably more natural and definite than for odors, and even than for tones, and was extremely uniform. The time which elapsed from the first introduction of a solution to the expression of its color was recorded by a stop-watch. This time approximated to 4 seconds. This may seem to give evidence of a deliberative form of judgment; but it must be remembered that some time was required for the spreading of the solution over the tongue, and an appreciable time for the functioning of the nervous processes underlying the sensation,—and further that *R* is generally slow in

expression. Moreover, his introspection bears out this assertion of spontaneity; *e. g.*, when salt was tried, the report was: "The color ($R\ O_2$) came as soon as the taste was nicely round my mouth. Then it gradually faded. This color is part of my 'salt consciousness' just as much as the name 'salt.' The color, the taste, and the name are parts of a whole, like the separate notes of a chord."

Table XIII contains results for each taste and for combinations of tastes obtained at three different times. The time of reaction is included in the majority of cases. Like tastes are grouped without regard to the day upon which they were tested. The only lapse from uniformity is the single instance of acid as red. This may be due to the fact that acid was unpleasant in this one trial.

TABLE XIII.

Tastes.

r.	TIME. SECS.	COLOR. PLATE.	COLOR. QUALITY.	FURTHER INTROSPECTION.
Sugar,	3.5	I.	B	r pleasant. A clear, bright B.
Sugar,	3.0	I.	B	r getting sickish. B still pleasant.
Sugar,	——	I.	B	
Acid,	4.0	I.	G to GBG	r pleasant after the first moment. Bracing. Recognized as acid.
Acid,	7.0	IV.	R_2	Acid, unpleasant. (Large mouthful.)
Acid,	3.5	I.	G to GBG	Pleasant.
Acid,	——	III.	GBG_2	Less bright than previous acid green, because r tasted differently.
Acid,	——	I.	BG	r not so biting as before,
Salt,	3.0	IV.	R_2	Pleasant, salt. A dull R.
Salt,	4.0	II.	RRO	" " " " "
Salt,	3.0	I.	RO_2	Color came as soon as the taste.
Bitter,	——	II.	RO	
Bitter,	10.0	II.	YO_3	Color a yellow brown. r too weak, hence the long time.
Bitter,	4.0	III.	RO	Pleasant, bitter. Color is a nice, dark brown.
Sugar and Acid,	4.5	III.	BG	A greener blue than with sugar. Recognized the two elements in the solution but not until the color had been assigned. (By mistake, the beaker had not been rinsed of acid. Sugar only was intended.)
Sweet and Salt,	7.0	IV.	B_1	r very unpleasant, sweet and salt. A dull, muddy blue.

Beside these photisms with the standard tastes, *R* assigns colors to many dishes; but their colors are often due to the actual color of the things themselves. Some of these assignments are given in Table XIV.

(4.) *Phonisms.* We have already mentioned an instance of tonal pain. A similar case occurred to *R* during experimentation. He suffered from a stiff neck, which 'sounded' like f^1 and g^1 simultaneously struck upon the piano. *R* had tried pressures at home, but not systematically. He thought he could have picked out piano tones to go with them.

TABLE XIV.

Dishes.

FOOD.	ASSIGNED COLOR.
Meats,	Dark yellow, dark red, and dark brown.
White bread,	Pale sickish white.
Graham bread,	Rich red.
Milk,	Light yellow.
Bread and Milk,	The color of a cup of cocoa.
Apples,	Some are Plate III, G. Other (riper) are reddish violet.
Peaches,	Rich dark red.
Bananas,	Light yellow.
Grapes,	Blue grapes taste reddish violet.
Ice Cream,	Chocolate or coffee ice cream is the brown which is assigned to bitter. All other ice creams are blue.
Cocoa,	Has no color, but if there were any match it ought to be like pale reddish violet light thrown on a brown screen. (This effect has never been seen by *R*, but he thought that it ought to be the proper thing.)

In the laboratory we found it easy to arouse in *R* mild clear tones of definite and determinable pitch with pain, pressure, and temperature stimuli. These tones were subjectively indistinguishable from the tones aroused by imaging or recalling music.

(*a.*) *Pain.* The algometer, pressed between the palms of both hands till pain was sensed, produced at 3 kg. d^1, at 5.2 kg. $b^{flat\,1}$. A pressure of 2 kg. on the sternum occasioned a pain equated to e^3, one of 2.1 kg. a c^4. After the hand experiments *R* involuntarily looked at his hands to see what the tone should be.

(*b.*) *Pressure.* Stimuli for pressure were obtained by the application upon the forehead (median area) of a single Griesbach æsthesiometer point, either with the rounded or the sharpened terminal. A preliminary series with the rounded terminal disclosed the fact that, within certain limits, duration of pressure was equivalent to intensity of pressure. Upon application of a given constant pressure a tone was at once heard which moved up steadily about an octave and a fifth during the first seven or eight seconds of the pressure. After this the tone remained upon the niveau which it had gained, for the remainder of the period of application.[1] Accordingly, a second series was undertaken in which that tone was recorded which corresponded to the pressure at the end of 10 seconds. In every case the tone had reached a level at the time judgment was pronounced. The subject picked out the tone from the piano, so that the error of recording cannot exceed a half-tone. He was especially cautioned not to confuse his estimation by an octave, and he felt confident that this error did not appear. In every instance in which the progressive tone series broke with the progressive pressure series, the apparent discrepancy was elucidated by the introspective report that the pressure actually sensed (owing to

[1] We did not experiment with any pressures of over 20 seconds.

irregularities in the sensitivity of the points stimulated) was a variation from the general progression of the series. Once a cold spot was excited, and no tone was heard. The highest tone given in Table XV (f^1) was louder than the others. In general, the tones were so mild that in order to pick them out, the soft pedal of the piano had to be kept down, and the keys to be struck pianissimo.

TABLE XV.

Pressures. (Blunt.)

r. GRAMS.	TONE.	REMARKS.
10	e^1	
20	f^1	
30	——	Struck a cold spot.
30	d^1	
40	a^1	
50	e^1	
60	a^1	
70	b flat 1	This pressure seemed to change suddenly at the removal.
70	b^1	(20 seconds pressure.)
80	d^1	r felt much less intense than the preceding one.
90	c sharp 1	
100	e^1	
110	f^1	

The lower tones ascribed to the last four pressures are due to a lessened sensitivity, probably from general or local fatigue. The tones were all localized at the point of application of the pressure.

The sharpened terminal was applied on the same forehead areas with pressures of from 10 to 50 grams. The stimuli, as Table XVI shows, were generally painful, especially at the first moment of application, when *R* often involuntarily shrank away from the point. The tones, though louder than those of Table XV, were still mild and pleasant, with the exception of one discord which the introspection entirely explains.

TABLE XVI.

Pressures. (Sharp.)

r. GRAMS.	TONE.	INTROSPECTION AND NUMBERS.
10	a^2	Tone fairly loud, pure and pleasant. Pressure slightly painful.
20	a^2	Slightly painful when first felt.
30	d^2+e^2	Tone was a jarring discord. The pressure was more intense, slightly painful, and unsteady. It associated the scratching of a cat. (Due to sidewise movement of the point?)
30	b^1	Tone localized in a small round spot just above the stimulus. The pressure aroused a fine pain at the very point of application, but the pressure was less than in the preceding trial. (The point was applied to the left of the median region.)
40	d^2	Less painful than some of the above.
50	c^1(?)	Pain sharp. Pressure obscured. Tone uncertain.
50	e^2	Sharper pressure. Painful.

(*c.*) *Temperature.* We have mentioned that *R* thinks of the plunging of his hands into cold water as bright red. A very slight warmth matches a very low tone, but this match is mediated through the pale yellow color of the Appunn low forks. Aside from these two instances of colored temperature, all the associations with cold and warm sensations are those of tone. *R's* right hand, *e. g.*, became quite cold during one of the experiments. After feeling it with the left hand, he assigned to it the tone a^1. It is significant that cold hands are bright red and that a^1 is also bright red.[1] On another occasion the cold left hand felt g^1. Curiously enough, *R* asserted that he was utterly unable to pick this note upon the piano when striking the keys with his right hand, but got it easily enough with his left. The following are the experimental results.

(I.) *Warm.* The stimuli were given with the point or the butt end (1 cm. diameter) of a Goldscheider brass temperature cylinder, heated in most tests to 45° C.

(a.) *Warm Areas.* Preliminary tests with lesser warmth gave repeatedly upon areal stimulation of the back of the hand the note A_1. A much warmer rod, rather unpleasantly hot, gave the fusion f^1–a^1.

More extended tests with areal stimulation at exactly 45° C. gave upon the forehead B, a, e^1, f. Despite the constancy of the objective stimulus, the variations in sensitivity were very great, and the subjective intensity of the warmth varied directly as the pitch of the tone which was heard. In the next test, the stimulus was repeatedly applied upon a single place, giving in succession the tones a, B, c, d, b. The right cheek gave c^1; the plantar side of the wrist gave only a slight warmth and the correspondingly low tone g^1; the back of the hand gave scarcely any sensation of temperature and no tone.

(b.) *Warm Spots.* The exploration for warm spots was performed with the Scripture temperature cone. Two spots stimulated with a temperature under 45° C. gave c^1. With a temperature of 45°, every warm spot found gave f^1. Upon the cheek, three warm spots gave c^1.

(II.) *Cold.* The cold stimuli were given with a Goldscheider cylinder which had been cooled in melting ice.

(a.) *Cold Areas.* Areal cold stimulation upon the forehead was heard as f^3, $c^{\text{sharp}\,3}$, and $e^{\text{flat}\,3}$, upon the cheek as f^2 and $c^{\text{sharp}\,2}$; upon the back of the hand no tone resulted.

(b.) *Cold Spots.* Upon the forehead cold spots afforded the tones b^2, f^2, f^3, upon the cheek e^2 and g^2.

While these phonisms of temperature are necessarily irregular, in view of uncontrollable variations in the intensity of the sensations excited at different places and at different times by the same objective stimulus, it is not difficult to see that departure from the physiological zero in either direction produces a phonism which rises in pitch with the increasing intensity of the cold or warmth.

(5.) *Miscellaneous Synæsthetic Phenomena.* Again in contrast to *M*, *R* has no tendency to personify and no coloring of the alphabet; with the exception of two verbal associations

[1] See Table VIII.

("e" is yellow, the sound "ou" is blue). He has no coloring of voices, words, or dates, and no alphabet form. But he has a month form, in which the year rises from January to December in a steep curve.

Discussion of the Results.

The systematic investigation of these two cases of synæsthesia has brought out several facts which seem to us to be of importance.

1. A subject may declare himself to be possessed of colored hearing or similar secondary sensation systems, and yet be quite unconscious of the variety, depth, and uniformity of these associations until complete laboratory tests are instituted. For these reasons, the questionnaire, which has hitherto been practically the only method applied to these phenomena, is essentially inadequate and unsatisfactory.

2. Investigators must be prepared not only for a considerable degree of variation as between different individuals, but also for variation within the same individual.

3. The determination of the genesis of synæsthetic phenomena is difficult. Even serious laboratory investigation, supplemented by a more than ordinary introspective ability upon the part of the subjects, has not enabled us to discover the essential basis for many of the facts which have been cited. It can only be said that *R's* secondary sensations are directly, *M's* indirectly conjoined to their primary sensations. The mediating link for *M* is an affective process, probably based upon a mass of organic sensations.[1]

4. As a corollary from these propositions it follows that generalization is at present to be avoided.

As an illustration of this point we may note the lack of concordance of our results with some of the generalizations of Bleuler and Lehmann.[2]

a. "Bright photisms result from high pitches, intense pains, sharply defined touches." For *M* the highest Appunn forks gave no photisms. For *R* the highest notes are essentially characterized by the introduction of green into the series, while the highest note gave a Plate V color.

b. "The same secondary sensation always corresponds to a given primary impression, but it may be modified by the prevailing ideas." This proposition is plainly negatived by the very vivid but very irregular photisms of Case I.

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[1] *Cf.* the opinions of Féré and Flournoy as summarized by Clavière, L'Année Psychologique V, p. 173.

[2] The passages designated by quotation marks are not intended to be literal quotations of Bleuler and Lehmann. See especially *op. cit.*, p. 96.

c. "Taste and smell photisms are located in the mouth and nose."[1] *M* projects clouds of light as with tones. *R's* colors are not localized.

d. "The order of frequency in colors is red, yellow, brown, blue; violet or green is seldom had." *M's* colors are predominately green if anything. *R's* list abounds with violet. Yellow is quite rare in both cases.

e. "Louder notes give more extended photisms." This has already been shown not to hold good in Case I.

f. "Pleasant delicate odors and tastes make pleasant, little saturated colors."[2] *R* had colors of the greatest possible saturation with tastes which were so weak as to be hardly recognizable.

5. The taste photisms of *R* seem to be worthy of special mention. Flournoy[3] mentions a few scattered instances of taste colors. Eberson[4] sees sour as blue, bitter as red or yellow. Bleuler and Lehmann[5] give bitter as dark brown or black; salt and sweet as bright colors; and add that mixed colors are never obtained. We have already noted that *R* gives uniformly sweet as blue, sour as green, bitter as orange-brown, and salt as dull red, and that mixed tastes induce mixed colors.

6. The phonisms to pain, pressure, and temperature possessed by the subject of Case II are, so far as we are aware, without parallel in the published accounts of synæsthesia.[6]

In view of the scattered nature of this literature, it is, however, quite possible that previous investigations upon this point may have escaped our notice.

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[1] *Op. cit.*, p. 42.
[2] *Op. cit.*, p. 40.
[3] *Op. cit.*, 109 ff.
[4] Ueber colorirten Geschmack, Wiener Presse, 1897, No. 49, p. 1542.
[5] *Op. cit.*, pp. 41–2.
[6] Attempted classifications of synæsthesia have, of course, recognized the possibility of these, as well as of many other correlations between the various modalities. Note, for example, the exhaustive schema of Suarez de Mendoza (L'Audition Colorée, Paris, 1890), to which Clavière refers. *Op. cit.*, V, p. 162.

THE SYNTHETIC EXPERIMENT.

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§ 1. Analysis and Synthesis.

Nothing is more striking in the pages of current psychological literature than the extensive record of analytic work. Analysis is, certainly, one of the essential ingredients of the atmosphere of science; and it is not therefore surprising that, with the splendid examples of physics and biology before it, psychology should seriously attempt the reduction of its material to the lowest convenient terms. Although its errors in this regard have been eagerly pointed out from time to time, it is safe to say that the necessity for psychological dissection is not likely to be called in question. But the matter stands differently with the interpretation of analytical results; upon this point turn many disputes. One psychologist contends that analysis is an end in itself: that one goal of the science is to know how mind is made up; what the ultimate bits of mind are. Another, that analysis is an indispensable aid to the study of genesis. Another, that it sets forth the psychophysical couple, and by its help indirect causal explanation is made possible.

Instead of discussing these various views, the writer wishes to point out still another way in which analysis may be turned to account: namely, in breaking ground for a constructive treatment of consciousness.

If an analytic result shows the true elemental constituents, it should be possible, at least in a good many cases, by adding the elements one by one, to rebuild the original experience. Surely no better test of the accuracy of an analysis is possible than the reinstatement of the whole through synthesis of the products of dissection. It is, to put it in another way, theoretically possible to devise and carry out a synthetic experiment on the same plan as an analytic experiment is conducted. If we take advantage of special and constant conditions for the dissection of mind, why may we not as well make use of these conditions in building up mind again? To make the matter concrete: why should we not, if we find that liquidity is a perception made up of a number of known elements, bring these elements together artificially and produce the perception in

question? There is surely no new theoretical difficulty, at least. The present article proposes a very brief outline of experimental syntheses with one or two concrete instances worked through in detail.

It scarcely needs to be pointed out that the type of synthesis which is to be discussed is entirely different from the genetic type.[1] It is one thing to build up the identical consciousness that has just been dissected, and quite another to take the dissected bits of, say, the normal, adult consciousness and entrust them, as protopsychic units, to time for the creation of a mental phylogeny. Very grave objections may be made to the second procedure.

In general, our synthetic experiment will consist just in putting together artificially the elements into which we have previously dissolved a complex experience. The experiment will be a psychophysical one, as the analytic one usually is, because it will manipulate the conditions under which the experience arises. The tests of its validity will be two: (1) it will produce the experience without extraneous suggestion, and (2) it will produce the experience only when all the elements which it includes are present. When its validity is assured, it will furnish an absolute check upon analysis.

The artificial construction of consciousness is not, indeed, an esoteric process known to psychology alone. The alchemy of æsthetics has used it for centuries. The pictorial vehicle for conveying beauty is a fabrication of psychological elements. A crayon or a pigment gives the adequate stimulus to a color or brightness sensation, and the premeditated arrangement of these is the visual colligation which the artist *uses* to express his conception. The more fully the actual elements present suffice to elicit the psychological complex, the more truly is the operation a synthetic one. For there are very different degrees of synthesis. A bit of shadow in the woods may touch off the perception of a mounted warrior, or of a deep cleft in the soil, but only by way of suggestion. The actual presentation calls forth a very meager conscious reaction if the proper trend to consciousness be lacking. It is, one may say, only the train which explodes the mass of material already gathered and arranged. In the truly synthetic experiment, on the other hand, the materials are carefully sorted, brought together and fed to the psychophysical machine. Thus in the production

[1] The latter type is represented by Dr. Stout, who first makes an analysis of mind (*Analytic Psychology*) and on the basis of this analysis (see preface) constructs his scheme of development (*Manual of Psychology*), starting with the sensation or the 'sensation-reflex,' "the most primitive form of mental life which is distinctly recognizable" (Manual, p. 126).

of a painting, the æsthetic pronouncement which is called forth cannot be said to be synthetized, but only the color-brightness colligation from the pigments and the canvas.

§ 2. The Province of Synthetic Experimentation.

It follows from what has been said that the range of synthetic experimentation is much narrower than that of analytic. The former avoids suggestion and works only where all the factors can be easily controlled. The experimenter here copies nature. He sits, for the time being, before the "whirring loom of time" and plies the weaver's craft. Either he presents a bit of made-to-order environment to the organism which he considers for the moment as merely a psychophysical receptacle, or he manipulates the factors in a conscious movement or an emotion, contemplating the mind as a theater for staging a characteristic action or a dramatic situation.

It is not always easy to decide when one is reconstructing synthetically. As has just been pointed out, a mere cue to the organism, which sets up an elaborate reaction, is not to be regarded as a synthetizing stimulus. Suggestion must play no more or less important part than it does in the face of the usual 'normal' situation in experience. Where nature has compounded a situation, experiment simply stands in her stead.

The second difficulty arises from the similarity between our experiment and certain forms of illusion. This applies within the field of perception. The term "illusion" is used broadly and loosely in psychology. It may include, for example, every kind of trick to which the normal consciousness is liable. Tricks from the nervous mechanism (*e.g.*, phenomena of double conduction); tricks from peculiarities of the sense-organs (*e. g.*, the binocular vertical); tricks from association (*e. g.*, the size of the moon); tricks from judgment, memory, imagination, apperception. Since we have no definitive account of illusions from a systematic standpoint, it is useless to attempt a clear description of them. One has only to recall the multitude of theories: "intellectual," "perspective," "contrast," "confluxion," "mechanico-æsthetic," "physiological," and the host of interpretations, to convince oneself not only of the lack of finality in arrangement and explanation, but also of the heterogeneous nature of the matter crowded under the general heading.

The subject of illusions spreads itself over well nigh the entire field of psychology. Even within the geometrical illusions of sight—the type most thoroughly worked over—we have, without doubt, a number of distinct cases, arising from a variety of conditions. There will be no cause then for confusing the *general* field of illusions and the quite definite class of syntheses.

If it be insisted that both illusion and synthesis imply trick-

ing, it may be answered that from the psychological point of view a trick is the essence of neither. An illusion, as experienced, shows no trace of deception. It is simply a straight-forward experience which has, for psychology, no price set upon it. Only when it is given a value in a general system of experiences is it found to stand at a discount. One may say in the same way that the synthetic perception contains in itself nothing like deceit. It is made up of a collocation of *bona fide* elements. It is only when one views the perception externally, looking into the elements one by one, that one sees traces of the artificer.

Doubtless, instances will arise which we shall be inclined to classify both under illusions, as they are now conceived, and under syntheses, in the sense of the text; but this furnishes no reason for identifying the two classes.

To avoid confusion, the following points of difference between the illusion and the perceptual synthesis may be noted.

(1.) An illusion reveals a discrepancy when brought into juxtaposition with similar experiences; a synthesis does not.

(2.) An illusion may depend upon other factors than environmental (eye muscle strains, fixation), or may even arise without any peripheral stimulation (as an illusion of memory); a perceptual synthesis depends upon environmental circumstances only.

(3.) An illusion may be entirely compounded by nature (as the illusion of the size of the moon); a synthesis depends upon experimental artifice.

(4.) An illusion may arise in one part of an experience-complex through the operation of an adjacent part (*e. g.*, many optical illusions, as the parallel lines in the Hering and Zöllner patterns, the Müller-Lyer lines, interrupted extent, the inscribed square): in the perceptual synthesis, the perception is a unit; all elements retreat into the background and unite in producing the perception.

In general, illusion implies perceptual torsion. The cause for the torsion may lie either within or without the organism.

The individual builds his world under the guidance of convenient norms and units. This guidance is absolutely necessary, since experience varies from time to time and from circumstance to circumstance. When, now, a given experience is found to vary from its appropriate norm, the individual is said to fall into an illusion. The norm is violated or the unit changed in value. The synthesis, however, is compounded from nature's 'standard' prescriptions, but not at her hands. The general formula reads, for the cases which we have cited: $\alpha + \beta + \gamma = P$, where the small letters stand for the ingredients, and P for the resulting perception. If we write for the ordinary perception, $a + b + c = P$ we shall have for the illusion $(a^1 + b^1) + c = P^1$,

where $(a^1 + b^1)$ represents a partial change in the situation which 'distorts' P. The expression $\pm (P^1 - P)$ would stand, then, for the quantitative measure of the illusion. If now the torsion be given artificially the last equation will read $(\alpha^1 + \beta^1) + c = P^1$. The parenthesis indicates that a *group* of elements is usually manipulated in the illusion, whereas each element stands for itself in the making of the perfect synthesis.

We have, finally, to distinguish experimental synthesis from a group of experiences in which quite a simple stimulus produces not its normal (usual) effect, but a new one. Take, as an instance, the apparent movement of a bright point fixated in an absolutely dark field. Movement is perceived, although the adequate stimulus to movement is probably lacking; there is, however, no deliberate synthetizing of the perception. If, on the other hand, a rapid succession of exposures, slightly different (as in the zootrope), be made, under suitable conditions, the movement perception is easily compounded.

§ 3. Types of Experimental Synthesis.

All the instances that have been cited, thus far, are instances of perceptual synthesis. They are syntheses of the first order; they stand on the lowest level of concrete experience and their constituents are the simplest possible. A good many instances of this type might be given. In vision, we have a typical instance in the stereoscopic representation of depth. Analysis has given the 'dimensions' of binocular space perceptions; stereoscopy has put some of these together synthetically. The pseudoscope, too, furnishes the conditions for a similar synthesis; and, finally, the stroboscope completes the synthesis of a third great class of visual perceptions.

Professor A. Kirschmann has given a good example of the synthetic procedure in vision in the artificial construction of metallic lustre done in connection with his study of the parallax of indirect vision (*Philos. Stud.*, XI, 147 ff.). After recalling the possible visual factors—qualitative, intensive, spatial and temporal—into which the perception of lustre can be analyzed, he proceeds, by elimination, to select the real elements. These he synthetizes in an *experimentum crucis*, and succeeds in constructing artificially (by means of gelatine sheets, etc.), the perception in question. This instance is peculiarly instructive because it shows the value of the synthetic experiment in case direct experimental analysis must, of necessity, be replaced by indirect and logical processes.

Closely allied to Kirschmann's experiment, is Wundt's synthesis of the reflection of objects, in their proper colors, by a colored, highly polished object. The synthesis is made for both monocular and binocular vision by the use of reflected images.

(*Cf. H. and A. Psych.*, 199 ff., and *Grundzüge d. physiol. Psychol.*, 3rd ed., II, 177-8.)

In audition, the scope for synthetic work is not so broad as in vision; neither has the field been so well covered. Still, we have the synthesis of sound localization by the adjustment of binaural intensities and the synthesis of the note by the fusion of fundamental and overtones. There is still room for much construction in creating the clang-tint of instruments by intensity gradations among the partials, and the addition of appropriate noises.

Among tactual perceptions, involving cutaneous and subcutaneous sensations, there is still more to be done. These perceptions will be taken up somewhat fully later; hence a discussion of them here may be omitted.

Finally, our programme of perceptual syntheses demands a place for taste and smell complexes. These senses are very strongly affective and quite weakly perceptive when they stand by themselves. Odors, it is true, betray by their names a strong tendency to arouse ideas—they are active incentives to association—but for this very reason they do not serve well in the class of experiments which we are considering. They are too suggestive. We get, however, some fairly good synthetic material by the addition of tactual factors to taste and smell. The perception of many drinks—as cider, lemonade and wines—is probably quite capable of synthetic imitation through these three factors.

Are there, we have to ask now, synthetic experiments outside perception? Is artificial construction feasible in any other way than by bringing to the organism elements which, when taken in together, mean an object-in-the-world? Let us look at some other forms of consciousness for an answer to this question.

We turn naturally from perceptions to feelings, because feelings stand on the same general level as the simpler perceptions. But when we attempt to synthetize feelings various difficulties confront us. (1) Pleasantness and unpleasantness, the most prominent elements in the feeling, denote a more general reaction than sensation and are, therefore, less amenable to control. (2) The sensations most prominent in the simple feelings are organic; hence they are less accessible to experimentation. (3) But the most formidable difficulty is this: a simple stimulus conditions at once the sensation and the affection. Piecemeal construction of the complex is, for this reason, impossible.

When, however, we ascend to the level of the emotion, we find that these difficulties are less serious than in the case of feelings. Indeed, if we were to work upon the basis of a 'Reverberation' theory, the reconstruction of all the typical emotions would be conceivable. Instead of a situation acting

indirectly upon muscle, gland, blood vessel, and viscus, the function of these would be altered more directly and in such a way as to kindle the emotion. It would, doubtless, be asking too much of such a theory to expect a reproduction of all the emotions under experimental conditions; but certain of them ought surely to lie under control.

Professor James remarks (*Psychology*, II, 450) that "the immense number of parts modified in each emotion is what makes it so difficult for us to reproduce in cold blood the total and integral expression of any one of them. . . . Just as an artificially imitated sneeze lacks something of the reality, so the attempt to imitate an emotion in the absence of its normal instigating cause is apt to be rather 'hollow.'" Still, he shows later that not only are 'objectless' emotive states common in mental pathology, but that voluntary arousal of emotions is quite possible within limits (462 ff.). Lehmann criticises Lange (*Hauptgesetze, etc.*, 114 ff.) for his identification of ordinary emotions and those simulated by the use of drugs. He himself contrasts the "normal" emotion (the emotion arising in face of a situation) and the artificial. The essential difference is, he thinks, that the first is consciously motived, while the second is not. Considered psychologically, then, the normal and the artificial emotion cannot be identical, though both may lead to the same changes in motor innervation.

So far as the matter of emotive architecture turns upon a point in theory it may, of course, be neglected, since the present outline aims only at indicating a general scheme. Evidently, the success of the synthetic procedure depends, in the present case, upon the true nature of emotion and the essential conditions which underlie it: matters which we cannot discuss here. Even though we adopt Lehmann's conservatism, we may still include simulations under emotions, and thus make a way for our method.

One must by all means guard carefully the purity of the emotive synthesis: one must ask whether all the necessary conditions have been actually arranged for, or whether association (as association of facial contractions, swallowings and forced tears with sorrow) takes the event well toward the limits of the experimental type. These are questions for experiment and introspection, not for theory, to settle. We cannot say that, at present, there is any satisfactory method known to experiment for synthetizing an emotional state by way of its immediate physiological conditions. Nevertheless, the success of crude attempts at producing fear, sorrow, and joy makes the case hopeful.

But more important still is the fact that the reconstruction of an emotional situation is among the resources of the laboratory.

Of course the synthesis does not issue from the simplest elements as in the perception; but that is scarcely to be expected in so complex a consciousness. It must also be said that the emotional situation is so often a matter of human relationships that no hard and fast line can be drawn between natural and artificial instances.

We have still to discuss the class of experimental syntheses which have been, thus far, most serviceable to psychology: the class of artificially synthetized *actions*. Action, particularly in its simplest forms, is so fleet-footed that introspection has well-nigh despaired of overtaking it. It is by all means desirable that it be brought within bounds. This is accomplished by the Reaction experiment. Whatever else the Reaction experiment accomplishes, it gives the coveted opportunity for building up, piece by piece, conscious action as simple or as complex as the psychologist desires. If action included only movement and its results in consciousness we should be dealing simply with another case of perceptual synthesis: the perception of movement. But action is more; it starts with the apprehension of a stimulus, runs through various intervening processes, which vary with the type of action, and issues in movement.

The limits of the action-synthesis are these: (1) it brings the action-stimulus to the organism instead of allowing it to evolve centrally (as the result of ratiocination, *e. g.*); (2) it presupposes rather than creates an action attitude: that is to say, it gives a stimulus which would not necessarily lead to action under natural conditions; only when the connection of action with the artificial stimulus is arranged beforehand is the action completed. Finally (3) the purity of the synthesis is somewhat impaired by the central concomitants (memory, expectation images, choice, etc.) of action.

These limitations are, however, not so serious as they seem to be at first sight, for (1) the objective situation is the usual and, without doubt, the original incentive to action; again, (2) with numerous repetitions, the artificial stimulus assumes more and more the characteristics of the normal excitant to movement; and, lastly, (3) although the synthesis is not pure, the situation is actually reconstructed and the central accessory processes are controlled by variation of conditions.

We found in synthesis of the first type that the more one interpolates associative processes the farther one gets from pure synthesis. Now such processes do come in prominently in various forms of compound reaction, as well as processes corresponding to the logical terms judgment, inference, reasoning; but there is a difference. There the processes were interpolated quite loosely and took us beyond the immediate perception. Here they are not only integral parts of the synthetized action, but

they are directly controlled by the terms of the experiment. The importance of this type of synthesis does not need to be urged. The fact that psychology is able by its means to construct any grade of action from psychomotor to highly involved ratiocinative action, and thus to study the whole range of the action consciousness, shows its great usefulness to the science.

We must not in thus extending the limits of synthetic experimentation overrate its results. Even though we are successful in building up, for example, a perception out of the products of analysis, we cannot say, straightway, that a complete description is given of the structure of the perception in the enumeration of the elements. Putting the case in psychophysical terms, we are not warranted in saying that because a stimulus complex $\alpha + \beta + \gamma$ supplies the necessary conditions for the appearance of a given perception, the perception *is* only the sum of the elements which the stimulus represents. This may be true, and it may not: the synthetic experiment does not determine. Whether there are such things as "Tongestalten" or "Raumgestalten," "Gestaltqualitäten," "Complexionen," and "fundirte Inhälte," the synthetic experiment cannot decide. The discussion of these things turns upon the question as to *how* consciousnesses are put together: whether by a summating, or a consolidating, or some other process.

We seem at first thought to secure in the synthetic procedure all that was lacking in justification of analysis: namely, the assurance that it has dissolved the matrix of mind-stuff and got hold of all there is of it; but we find that we have only added the fact that the elements do work when put together thus and thus; not what is in the product, or sum, or creation, whichever it may turn out to be.

The justification of analysis that we have found is, then, a justification of particular cases. The validity of analysis, in general, we have not touched. As we said at the outset, we verify an analysis if, by reversing the analytical process, we come back to our starting point. The question whether or not mind, considered organically, but quite anatomically, is more or less than, or equal to, the sum of the abstract elements which our analysis reveals must be answered from a different plane from that of the present discussion. We hope to consider this question in another connection.

Leaving, now, the general aspects of the subject of synthesis, we come to the treatment of a particular set of problems which our method encounters; and finally, to the record of a single experiment in synthesis.

The class of perceptions that we have chosen are those arising through stimulation of the tactual organs, and the particular synthesis the artificial construction of liquidity.

§ 4. Synthesis of Cutaneous Perceptions.

The skin is burdened with offices. One of the surprises of physiology is the revelation of the multitude of functions performed by this apparently simple organ. As a rind it is not only the container, but the warder-off, and also the go-between for the organism and its world; tegument, buckler, interagent. It is small wonder that its work is represented in mental process; that many of our most worn and useful perceptions are made up of cutaneous sensations.

The antiquity of tactual perceptions—sharpness, bluntness, smoothness, roughness, wetness, softness, hardness, resistance, tickling, itching, traction, movement, and projection from the body-surface—must be very great. Most of them have had a high survival value in the race's history. The skin as the primitive sense-organ had for a long time to fight its own battles. It has come out not only unscathed but with its susceptibility greatly reinforced by the conflict. It breathes mind at every pore. Its tissue lies packed with sensation, waiting for its Helmholtz to spell it out.

Something has indeed been done in recent years to unravel the tangled skein of perceptions whose origin lies at the borders of the organism. Analysis has cunningly searched out the elements of the complexes and has pointed to the specific organs which condition them. Much systematic work remains. And a good deal of this will consist in putting together what has already been abstracted from the total mass. A bit of this construction we have attempted in the remainder of the study.

Liquidity.

A good deal remains to be done here by way of preliminary dissection. The apprehension of wetness is commonly considered something unique: the finger touches a wet surface, or the hand is plunged into a liquid, or the body is immersed, and one is said just "to feel wet." This is a striking instance of the confusion of mental processes and their significance; in this case, a confusion of sensation with perception. It is, moreover, hardly likely that liquidity is perceived through even an unique kind of sensation. Working then under the rule of the Law of Parsimony an attempt has been made in what follows to reduce liquidity to known sensational elements—we have pressure, pain, thermal,[1] tendinous, muscular and articular sensations to draw upon—and afterward to synthetize it *de novo*.

i. A series of liquids of varying specific gravities, degrees

[1] A striking case of thermal synthesis, worked out by S. Alrutz (*Mind*, 1898), p. 141, is the production of the 'hot' fusion by means of the simultaneous stimulation of warm and cold organs.

of viscosity and volatility was collected. This included mercury, petroleum, eldorado oil, water, molasses, benzine and ether.

In giving the stimuli, the first and prime precaution was to rule out other senses than the cutaneous and subcutaneous. The eyes were bandaged or kept closed, the nose (and when necessary the ears) stopped with cotton, and the member used kept quiet, or moved only under definite control. The middle finger of the right hand was used in most cases. Control experiments were made with all the fingers, with the palm, and with the whole hand and wrist.

With these limitations the perception of liquidity was marvellously narrowed down and simplified. The eyes and the nose are extremely useful (as in many other perceptions) in helping out the skin.

Instead of moving the finger into and out of the various liquids, it was found best to place the arm comfortably on a rest with the finger projecting over the edge, and then to raise and lower the containing vessel (a beaker of convenient size).

To avoid quivering of the liquid, the beaker was set in an elevator which was operated by a cord run over a pulley at the ceiling and wound upon a small drum. The drum was revolved very slowly and steadily by means of a long crank.

Suggestion was avoided just as far as possible. The subject was brought, eyes blindfolded and nostrils stopped, from an adjoining room before each experiment. The experiment consisted of three parts: (1) contact of the finger with the liquid surface ("ad"); (2) immersion of the finger about as far as the first joint ("in"); and (3) withdrawal from the liquid ("ex"). The test began as soon as the subject was comfortably seated; a warning signal (for the attention) was given before each of the three parts. The subject gave a running introspective account during the experiment and completed it immediately afterward. The operator kept the record-book. From four to nine records were taken in an hour.

Dr. W. B. Lane (L.) and the writer's wife (S.) kindly served as subjects. The writer acted as operator and occasionally as subject. The work was carried on in this laboratory during the winter term of the present year.

Results.

Before the investigation had proceeded far, it became evident that the cutaneous processes, when isolated, function rather clumsily: differences in density, viscosity, etc., passed unnoticed when color, transparency, odor, sound and lateral or irregular movements were wanting. For example, molasses, benzine and even mercury passed under certain thermal conditions for

water: an indication of how widely the organism is obliged to draw upon its resources for the completion of so simple a perception as that of a liquid.

The Tables which follow show the results for mercury, benzine and water: a heavy 'dry,'—a light volatile,—and a moderately heavy liquid. Results from the other liquids used need not be tabulated. The oils—petroleum and eldorado—stand between water and mercury in specific gravity: their oiliness disappeared under the conditions of the experiments. Only when there was a jar of the vessel, or a sudden movement of the finger, or a rubbing of two surfaces, was the 'oily' perception obtained. S did not once perceive 'oiliness' throughout the experiments. This perception remains to be worked out under Smoothness and Resistance. When the oils were distinguished from water and mercury, pressure intensity seemed to be the only criterion if the skin alone was concerned.

Ether and benzine gave similar results; the difference being the more intense cold after the removal of the ether.

Let us examine the tables. The stimulus is named on the left, then follow columns for the stage and number of the experiment, the subject, and his report. C = cold; W = warm; P = pressure, etc.; o = present; oo = present at a very high intensity; — = present at decreased intensity. Where no objective temperature is noted the substance has the temperature of the room. Temperatures were not kept in degrees because (1) the zero point of the skin shifts very greatly, and because (2) quantitative results were not in the least cared for, except where they could throw light on qualitative questions.

The results are pretty uniform. Pressure and temperature are evidently the two important factors in liquidity. The record shows that the pressure is of a peculiar kind. It is a close-fitting pressure, strongest at the tip and at the ring (when a ring is present). It has a tendency (naturally) to grow faint as it continues. Often when the member is immersed the subject is doubtful whether any pressure remains. Another peculiarity of the liquidity-pressure is its advance and recession: it creeps up and down. At first the subjects declared that the wetness was something added to the pressure and temperature: it was, for them, unique. Later L found in it a peculiar mixture of warm and cold, especially when a warm stimulus was given. There seemed in the wet to be little spots of cold sprinkled around in the warm.

To test the uniqueness of the 'wet' an experiment was arranged in which pressure and temperature were eliminated, while the stimulus was actually moist. The required conditions were obtained both with water and benzine. L, whose pressure limen for the finger is rather high, got no sensation (water

TABLE I.

Mercury.	Subj.	No.	C.	W.	P.	Remarks.	Ring.	Traction.	Perc'n.	Remarks.
Ad.	L.	1	∞							
	Li.	2	o		o					
	S.	3	o		o					
(Lukewarm)	S.	4		o	o					
"	S.	5				Tip in warm air.				
	S.	6	o		o					
	S.	7	o		∞					
	B.	8	o		o					
	B.	9	o		o					
In.	L.	1	—							
	Li.	2	o		o	Strongest at tip.	o			
	S.	3	—		o	On ball of finger.	o			
	S.	4		o	o	At tip.	o			
	S.	5					o			
	S.	6					o			
	S.	7	o		∞		o			
	B.	8	—o		—o		o			
	B.	9	—o		—o		o			
Ex.	L.	1			o	Clinging pull, then push.				
	Li.	2			o			o		Like water, but P. too great.
	S.	3			o	Dwindled to point.			Hg.	
	S.	4			o	Left at tip.	o			
	S.	5			o	Left at tip.				Warm air till finger moved, then water.
	S.	6			o	Dwindled to point.			H_2O	
	S.	7			o	Dwindled to point.			H_2O	
	B.	8	o		o	C. and P. disappearing.	o			Did not know when liq. left.
	B.	9	o		o	" "	o			

TABLE II.

Benzine.	Subj.	No.	C.	W.	P.	Remarks.	Ring.	Traction.	Perc'n.	Remarks.
Ad.	L.	1	o		o	P. less than water.				
	L.	2	o	o	o					
(Lukewarm)	L.	3								
	L.	4	o		o					
(Lukewarm)	L.	5		?						
	S.	6	o		o					
	S.	7	o		o					
(Lukewarm)	S.	8		o	o					
"	S.	9		o	o	Dry vapor.				
"	S.	10		o		No wetness.				
"	S.	11	o			"				
"	B.	12		o	o	"	o			
"	B.	13		o		Difficult to place W.				
In.	L.	1	o		o					
	L.	2								
	L.	3	o		?					
	L.	4	o		o					
	L.	5	o	o	?		o			
	S.	6	o	o			o			
	S.	7	o		o		o			
	S.	8		o	o		o			
	S.	9			o	No wetness.				
	S.	10		o		"				
	S.	11	o		o	Feathery (dry) P. in patches				
	B.	12		o	o					
	B.	13	o			Cold in patches. Dry.				
Ex.	L.	1						o		
	L.	2	o					o		Confused *ad*, *in* and *ex.*
	L.	3	oo							" " "
	L.	4	o							" " "
	L.	5	o							" " (Wetness after *ex.*)
	S.	6	o							" "
	S.	7			o				Benzine.	
	S.	8	o							No wetness.
	S.	9	o							Suppose it has been wet.
	S.	10	o							No wetness.
	S.	11	oo							No wetness.
	B.	12		—	o	Turgidity of finger-end.			Light Liquid.	No wetness.
	B.	13	o		o					Advancing wet.

Table III.

Water.	Subj.	No.	C.	W.	P.	Remarks.	Ring.	Traction.	Perc'n.	Remarks.
Ad.	L.	1	o		o					Wet.
(Lukewarm.)	L.	2								
"	L.	3			o					
"	L.	4								
"	L.	5		o		No wetness.				
"	L.	6			o	"				
(Cold.)	L.	7	o		o					Wet.
	S.	8	o		o				Hg ?	Wet.
(Lukewarm.)	S.	9		o	o					
"	S.	10		o						Leaving water, *ad* and *ex* confused.
"	S.	11								
"	S.	12		o	o					
(Cold.)	B.	13	o		o					
In.	L.	1	o		o					
	L.	2		o	?					Wet.
	L.	3	o	o	?					Wet.
(Cold added.)	L.	4	o	o	o				H_2O & Benzine	Wet. Wetter [when cold added.]
	L.	5		o	o	W. delayed.				Wet.
	L.	6	o	o	o					Wet.
	L.	7	o	o	o					Wet.
	S.	8	o		o					
	S.	9					o		H_2O	Wet.
	S.	10								
	S.	11		o	o					Wet. Immersed in liquid.
(Cold added.)	S.	12				Later got P. and C.	o		H_2O	Wet when P. and C. came.
	B.	13			o		o			
Ex.	L.	1	o		o	Receding.			H_2O	Wet.
	L.	2	o		o				Benzine.	Wet. Confused *ad* and *ex*.
	L.	3	o		o					Wetter when out, *i. e.*, cold.
	L.	4								
	L.	5	o	o						Wet at tip.
	L.	6	o	o		Wet going up.				Took *ex* for *ad*.
	L.	7	o	+o						Less wet than at *in*.
	S.	8			o	Receded to tip.				
	S.	9			o	Receding.				
	S.	10	o		o	Entering cool H_2O.				When temp. =o *ad* o *ex* gave no sens. or slight P.
	S.	11	o		o	Slight P. at tip.				
	S.	12								Confused *ad* and *ex*.
	B.	13			—o	Left, cold and wet. P. evaporated.			Liq. betw'n H_2O & Hg	

experiments 2 and 4, *ad:* benzine experiments 3 and 5, *ad*) when the lukewarm liquid was brought over the end of the finger slowly and carefully. Later, when the finger was well immersed, slight pressure and thermal sensations came, and gave wetness. This wetness was increased (water experiment 4, *in*) when cold was added. With S the pressure was not so easily eliminated. Still, where pressure stands without temperature (benzine experiment 9, *in*) no perception of wetness is formed. Similarly, where temperature (either cold or warm) stands without pressure (benzine experiments 10 and 11, *ad*, and 10, *in*) no wetness is given. Even when a feathery, patchy pressure is felt wetness is still absent (benzine experiment 11, *in*). B, also, perceived no wetness from warm or cold by itself (benzine experiment 13, *ad* and *in*).

From these facts we conclude that it is not the actual moisture, as such, upon the skin that gives the perception of wetness.[1] In several cases this has been present, but where either temperature or pressure was lacking 'wetness' was also lacking. An exception is made below for the heavier liquids. Further testimony concerning the elements in the perception will be given in the synthetic experiments.

We have still to note in this connection the differences in the successive stages of the experiment. The only factors which distinguish the perception of being-in-a-liquid from the perception of entering-a-liquid are (1) various changes in intensity and extent of pressure and temperature, and, occasionally, (2) the addition of a ring. The ring itself is easily shown to be only a more intense pressure than the rest, with, sometimes, temperature added. It is usually well-defined in the heavy liquids and vague or lacking in the light.

The upward movement was stopped at *ad*, and, after the report was given, continued. The continued movement was perceived by the subject as an advance of the liquid.

Since the sensitivity for pressure varies at different parts of the finger, the pressure was not equally intense at all places. It was most apparent on the tip and ball of the finger and at the edges of the nail. Still, there were no sharp limits to make the pressure seem patchy.

With the lighter liquids it is seen that the advancing, well-distributed pressure was not sufficiently clear to give the appropriate perception *when temperature was absent.* Mercury, on the other hand, gave a well defined 'snug' advancing pressure and was therefore perceived as liquid even without temperature. But it is a significant fact that mercury, when

[1] We avoided soaking the member; the shrivelling of the cuticle from long exposure to moisture undoubtedly furnishes an indirect means of determining the presence of a liquid.

cold, left a "wetness" after *ex.* Here, again, is a perception of wetness with no objective moisture.[1] The withdrawal of the stimulus was sometimes perceived as a recession toward the tip; sometimes as a mere 'evaporating' decrease in pressure with no change in extent; this with the lighter liquids or with a decreased sensitivity through the continued presence of a strong pressure stimulus. Finally, a bit of traction was sometimes noticed as the stimulus left the finger. This was most apparent with mercury. Whether traction is a unique sensation, incapable of analysis, we shall have to consider later. We find that with the lighter liquids at least—ether, benzine, water—it was not available for the discrimination of entrance and withdrawal. Concerning its peculiar nature we wish to remark by way of anticipation that we found by careful testing that a slight (though supraliminal) traction is easily mistaken for pressure and *vice versa.*

ii. We are ready now for reconstruction. We have found that the apprehension of liquidity when it is confined to the sphere of cutaneous perception consists, in its simplest form, of three parts: (1) entering, (2) being in, (3) withdrawing; that in this form, (a) the 'dimensions' of liquidity are pressure and temperature, and (b) the three parts are distinguished by peculiar combinations of these factors.

If, now, our analysis is correct, we are in a position to verify it by reproducing artificially the perception in the three stages just enumerated.

The first attempt at synthesis was made by stretching lightly a sheet of thin rubber tissue over the top of a beaker and raising the beaker in its elevator till it came in contact (*ad*) with the finger tip (right middle finger, as before). By raising the beaker higher, the finger sank into the rubber (*in*); and by lowering, the rubber was withdrawn (*ex*).

The following notes are taken from the record-book for the first trials.

Subject: L.

I *Ad.:* Slight warmth and pressure.
In: Pressure advances half way up nail; clinging, silky, *i. e.*, pressure at minute points.
Ex: Uneven pressure.

II *Ad:* Pressure too firm for a liquid.
In: Same. No advance on finger.
Ex: Pressure left. No traction as from a film.

Subject: S.

I *Ad:* Pressure.
In: Pressure extending irregularly; various intensities.

[1] Another bit of evidence is given by the well-known fact that mercury 'feels wet,' although it is actually dry.

Ex: Pressure left all at once except small place at tip. Semi-solid; perhaps gelatine.

II *Ad:* Pressure.

In: Pressure advancing: film. Pressure uneven.

Ex: Pressure receding: pulled off. Rubber.

The results, though quite negative, are instructive. The temperature and the intensity and distribution of pressure evidently are not right for wetness. To adjust the pressure-element, powdered soapstone was sprinkled on the rubber. Now L, perceived wetness at *ad*, but lost it as the pressure increased. S, who noted that pressure was evenly distributed and came around the finger, perceived a gelatinous substance as before. To relieve the pressure, the point of a burette was introduced to the beaker under the rubber sheet which was blown gently up and down. At *ex* the pressure was made to dwindle to a point by means of air-puffs, and L, then reported a perception of mercury or other heavy liquid leaving the finger. When mercury actually replaced the soapstone on the rubber his perception was the same. Again, the rubber tissue was tried with a breath of cold air driven across its surface. This L, declared to be a wet cloth, touching only near the tip. S, with greater sensitivity, noticed that the cold covered a larger surface than the pressure, and shifted. She thus detected the air blast and failed to perceive wetness.

Various powdery substances,—wheat flour and lycopodium powder,—were tried. The finger was introduced by precisely the same method as before. With L, flour gave at *ad* cold and pressure, and was judged to be a liquid (mercury?); this perception was killed at *in* by slipping and sticking, *i. e.*, irregular pressure; *ex* was observed to be unlike a liquid; there was no smooth, faint dwindling to a point. With B there was no temperature, and liquidity went no farther than "an unbroken film of heavy liquid" at *ad*. At *in* too great pressure at the tip killed the liquidity. S got decided wetness at *in*, with both cold flour and cold lycopodium; at *ad* wetness was doubtful, and at *ex* killed by the clumsy slipping-off of the substance.

To control pressure L, was given flour in a cloth funnel supported by the operator's hand. To simulate the liquid boundary a small brass ring (cold) was on the flour, and the finger was inserted. By carefully changing the shape of the funnel the pressure was regulated.

The introspective account follows:

Subject L.

Flour. *Ad:* Cold and pressure.

In: Greater pressure: more intense inside finger: then more evenly distributed. Ring at surface (pressure or traction?). A liquid.

Ex: Left at point like liquid, but drew off instead of rolling. Traction. Perception: a liquid plus a solid.

A repetition gave the same result, except that there was a jar at *ex.* The liquid at this point was said to be like mercury.

Here the synthesis was entirely successful except at the *ex.* Even here liquidity was not lost; only solidity added.

The effect of the advancing ring by itself was tried on S. A rubber band two millimeters wide was stretched slightly in the thumb and finger of either hand and passed slowly and carefully up the subject's finger. The record follows:

Subject S.
Rubber ring.
Ad: Delicate pressure at tip, and warmth.
In: Distinct ring advancing, and pressure below [doubtless after-image of pressure]; warmth. *A thick liquid.*
Ex: Descending pressure, stuck at one place. This unlike a liquid.

A beakerful of light cotton, slightly depressed in the center, was also used as a synthetic stimulus. With L, the stimulus gave the perception of mercury; this entirely from the distribution of pressure, evidently, since no temperature was sensed. A mercury stimulus had been used a few minutes previously, and the introspective analysis of the two experiences differed only in two minor particulars: (1) mercury gave a ring, and (2) its traction at *ex* was slightly greater than the cotton produced. S got cold and pressure from the cotton, but noticed a slight irregularity in the advance of the stimulus: however, wet was perceived at the tip and remained even after *ex.* (Analysis gave cold and pressure.)

To test this stimulus further the whole hand was immersed in a jar of cotton. L reported pressure and warmth: pressure increasing from "a cobweb-like feel" as the hand was thrust deeper into the substance. No perception was completed until *ex*, when "a heavy liquid like mercury" was reported. The member felt wet when entirely removed from the jar. A repetition gave the same result. S got cold and pressure: at *in* the perception was "clinging, sticky," and later, "perhaps, liquid."

Besides the liquidity perception which comes from immersion, there is the perception of a liquid as dropped-on. The synthesis of the latter was attempted as follows.

Subject L. I. Synthetic stimulus: filled circle of metal on palm.
Report: Strong pressure and cold. Wet? Wet after stimulus left.
II. Air blown on palm from glass tube.
Report: Pressure and cold spreading indefinitely from a point. Wet. Repeated four times with similar result. Twice pressure was not found; four times warm was found with cold. *Always wet:* "a volatile liquid, like ether."

S sometimes perceived a drop of mercury from the air blast, and sometimes perceived the air current (the pressure extending too indefinitely to be a liquid). A stream of cold lycopo-

dium powder was perceived as a liquid, which, however, soon disappeared.

Since the chief difficulty in synthetizing liquidity has been the production of an even, close-fitting pressure, it occurred to the experimenter to arrange a set of conditions which should offer all the advantages of liquid pressure, but which should exclude actual moisture. We saw some pages back that it was possible for a moist substance to be in contact with the skin without giving rise to the perception of liquidity. Now it is proposed to bar out moisture from the liquid stimulus and see whether a perception of liquidity will arise. To this end two methods have been employed. The first is as follows. A rather deep glass jar, eight centimeters wide at the mouth, was filled with water. A weight, two centimeters in diameter, was laid in the center of a large sheet of rubber tissue which was lowered into the liquid, its edges hanging over the sides of the jar. This formed a dry, blind pocket surrounded by water. The pocket was kept closed by the gentle pressure of the liquid. The middle finger of the right hand was inserted carefully, the water causing the rubber tissue to lie close to the skin as the finger descended. Cold (zero centigrade), warm and lukewarm temperatures were used. The results agree for the various observers—L, S, B, and several others. The cold stimulus gave a decided perception of wetness. This was occasionally marred by a slight pull or an unevenness of the tissue. The *ex* was the only part of the perception which was not well simulated. Occasionally it lacked the gradually receding pressure which a liquid gives. Many times, however, the whole course of the synthesis was complete, and did not disappear when the eyes were opened and the actual conditions observed. Warm water gave a less decided wetness, and lukewarm a very faint liquidity or none at all. The substances perceived were water, mercury and liquids of intermediate weight.

The second method was simpler. A thin rubber sheath was drawn over the finger, and the finger lowered into the liquid. The perception of liquidity here was complete, the subjects at first refusing to believe that the finger was not actually wetted. The perception lasted (with cold water) for some time after withdrawal.

Let us see what the net result of our work is. The *analysis* of the liquidity perception is too straightforward to need comment. We found simply that under certain definite conditions the perception could be factored with comparative ease. We then started our synthesis with all our terms known, and with the additional suggestion that moist substances do not neces-

sarily "feel wet." The first step was the bringing together of pressure and thermal conditions in the simplest, though the most artificial, way. The synthesis was, naturally, crude; but in the making we learned to handle our material, hence we were able gradually to eliminate disturbing factors and to make the synthesis cleaner and more clear-cut. We found by working with various materials that the actual substance used—whether a powder, a tissue, a rubber band, or a metal—made little difference so long as it brought together the essential elements in the necessary mode of combination. Having built up quite completely our perception, we turned to Nature for a hint as to refinement of method. We were not disappointed. Taking from her the ingredients which our previous essays had shown to be essential, but rejecting her superfluous ingredient—'moisture'—we got the neatest synthesis so far obtained; thus demonstrating that Nature, even when disabled, speaks to the organism in the most intelligible symbols. To be sure, the outcome of these 'water' experiments is so obvious that any one (with, perhaps, the exception of the experimenter!) might have prophesied it without hesitation. But it will be seen that the tests have a very great importance as they stand in the series.

It is not too much to say, then, that we have given a fair illustration of a somewhat novel, though important, use to which the results of analysis may be put: that we have shown that there is nothing unique in the elemental constituents of the perception with which we have been dealing, and, finally, that out of these constituents we have succeeded in building up, by way of experimental synthesis, the complete perception of liquidity.

PSYCHOLOGICAL LITERATURE.

Die moderne physiologische Psychologie in Deutschland, eine historisch-kritische Untersuchung mit besonderer Berücksichtigung des Problems der Aufmerksamkeit. W. HEINRICH. Zweite, teilweise umgearbeitete und vergrösserte Ausgabe. Zürich, Verlag von E. Speidel, 1899.

It is not easy to find a *raison d'être* for this work. As it is in the second edition it cannot wholly be attributed to what G. E. Müller calls a "*leichtfertige Productionssucht*," though the lack of constructive criticism, together with the remarkable number of critical errors, would seem to exclude any other theory. Assuredly, a critic who asserts that Külpe's "Grundriss" is scientifically of no importance (p. 151), whilst he refers the reader to Münsterberg's second "Beitrag" for a final solution of the time-sense problem (p. 64), would hardly be regarded by most psychologists as elected to fulfil the functions of the higher psychological criticism. The first 38 pages of the work are taken up with an historical introduction, running from the fall of Greek philosophy to Lotze; the necessity of such an introduction and its logical connection with the rest of the work are not obvious. In this historical introduction, however, the originator of Weber's Law is not considered.

In the preface Heinrich states that instead of applying his own opinions to the theories of others he proposes to use an objective standard of criticism in the shape of the doctrine of psychophysical parallelism. Beyond the general statement that the physical and psychical processes are to be considered separate, the reader is not informed what particular form of this doctrine Heinrich holds, until the close of the work, but is obliged to construct it from the several criticisms—a by no means easy task. But as weighed in this psychophysical balance, Fechner, Helmholtz, G. E. Müller, Pilzecker, Wundt and N. Lange, Külpe, Ziehen, Münsterberg, Ribot and Exner, are all found wanting. Avenarius alone stands the test.

The ground covered by Heinrich in his criticism of Fechner has, in the course of time, become pretty well trodden. There is one matter, however, in regard to which, perhaps, all psychologists are not clear, and which the counsel of Heinrich has made darker. In the early days of psychophysics von Kries objected to Fechner's theory of the direct measurability of a sensation by the liminal differences. His view was, as we now see, the correct one, that a sensation is not to be regarded as made up of a series of liminal difference units. Unfortunately he stated his objection in the form that one cannot say differences of sensation are like and therefore comparable. To this Fechner returned that differences of sensation could be compared, and that Plateau and Delbœuf had compared them. Heinrich's extraordinary criticism on Fechner's reply is to ask if the measurability of sensation is proven by experimental work (p. 51), and he lays it down hard and fast that differences of sensation are not comparable because they are not and cannot be 'given.' A logical deduction from this statement as well as from the assertion (p. 49) that different shades of red "appear quite as different as red and sweet," would be that the mental make-up of the author is fundamentally different from that of

all normal people. The correct view, as regards the first statement, probably is that Heinrich does not understand the import of the method of "mean gradations." He calls Fechner's view of the conservation of energy 'naïve': there is no doubt but that the view which Heinrich attributes to Fechner, viz., that the human body is "a system in which energy is directly transferable from the muscles to the brain" is naïve, but the naïveté is not Fechner's.

G. E. Müller's theory of attention Heinrich finds is out of date, and Pilzecker's elaboration of it is too schematic (p .79). The mistake which Heinrich makes in regard to Müller's views of psychophysical interaction (p. 69) arises from Müller's use of the terminology of Lotze.

It is on Wundt, however, that the phials of critical depreciation are most copiously poured out. Among other things, Wundt's theory of psychophysical parallelism is said to be neither clear nor decided, and in different works we get different views. In support of this Heinrich cites passages from the Physiologie, Psychologie, from the Essays, and from the Menschen-und Thierseele. The writer does not find these passages contradictory; but it is hard to see why, if Heinrich was in doubt in regard to their meaning, he did not refer to Wundt's 'official' declaration in the treatise on "Psychical Causality and the Principle of Psychophysical Parallelism" in the *Phil. Studien* (B. X. S. 1 ff). Heinrich cites this article in another connection (p. 143), and it is almost incredible and certainly inexcusable that he should have taken the condensed and popular presentations of the theory in text-books or essays as a basis for criticism instead of the elaborate special treatise or even the discussion in the Logik. Again Heinrich finds that, according to Wundt, our consciousness is made up of ideas and sensations. Feeling being a quality of sensation (p. 104). Again and again Heinrich errs in this way; he either has not read other treatises necessary to an intelligent criticism of a writer, or he has failed to grasp their meaning. The chief points in Wundt which move Heinrich to an expression of critical approval are the "general laws of cerebral functions," and the "incisive attack on cerebral localization" (p. 95). In connection with Wundt, Heinrich criticises N. Lange's work on the Fluctuations of Attention: Heinrich finds that the conclusions drawn by Lange have been "shattered" by Münsterberg (p. 125), whilst the supplementary researches of Pace, Eckener, Marbe and Lehmann, are refuted by his own experiments.

Külpe fares quite as badly as Wundt. Besides holding, as noticed above, that Külpe's "Grundriss" is "scientifically of no importance," Heinrich finds that Külpe's own views rarely appear in his work, and when they do appear they are sterile. Külpe, we are told, tries to give us a descriptive psychology, but his habit of looking at things from the rationalistic standpoint has entangled him in the rationalism of Wundt's theory of apperception. Külpe may think he has treated his subject descriptively, but Heinrich warns him sharply that description is no mere "loose collocation." All this on p. 151. In consideration of this sort of criticism, Heinrich's complaint (in the appendix to the second edition) of the "authoritative tone" in Külpe's article on "Attention" (*Zeitschrift f. Phil. and philosoph. Kritik*, Bd. 110) has many of the elements of humor. Of Külpe's well-known chapter on "Reproduction and Association"—than which there is none weightier in any systematic treatise on psychology—Heinrich finds nothing better to say than that Külpe has failed to 'explain' the association processes physiologically.

In Münsterberg, however, Heinrich finds much to praise. Armed with the experimental method "Münsterberg stepped forth to the fray," *i. e.*, with Wundt; the result being that "Wundt's followers are steadily

decreasing." This result is probably as surprising to Münsterberg as to Wundt (p. 154). As contrasted with Wundt, Münsterberg is said to be freer from popular prejudice and keener in the analysis of his problems (p. 158). Still Heinrich finds Münsterberg wanting in the psychophysical test; in his discussion of association, for example, he limits himself to an analysis of the processes of consciousness instead of laying bare the underlying physiological processes. Ribot's theory of attention is criticised as representing Münsterberg's view.

Ziehen also is found not to be rigorous enough in the physiological side of his psychology (p. 175), in that he has asserted that there are factors in our mental life for which a material basis is wanting.

Even S. Exner's "Entwurf zu einer physiologischen Erklärung der psy. Erscheinungen" Heinrich does not consider strenuous enough physiologically; whilst in many ways he merits critical approval, still he too has "jumped over to consciousness" in his explanation instead of keeping to the nervous system.

With Avenarius's speculative views, so far as they can be applied to the concrete problems of psychology, Heinrich finds himself mostly in sympathy, and to an exposition of these views he devotes 23 pages.

The writer has thought he could better illustrate the worth of Dr. Heinrich's criticism by a résumé of his conclusions in regard to the authors he has discussed than by a critical review of his arguments—a long and probably not wholly profitable undertaking.

In regard to the way in which Heinrich has applied his psychophysical standard and his somewhat drastic treatment of Wundt, it may be considered an act of poetic justice to quote a passage from Wundt's Logik, written some time before the appearance of the first edition of "The Modern Physiological Psychology in Germany." In the second part of the "Methodenlehre" (2nd ed., p. 254), Wundt says "that a naïve ignorance of the actual standpoint of scientific thought is betrayed in the view sometimes found in psychological work, that, according to the principle of parallelism, a physical correlate belongs to every psychical process, and inasmuch as the physical chain of cause and effect offers the advantage of perfect continuity, a psychical process is really explained only when the corresponding physical processes are pointed out." F. A.

Des Indes à la Planète Mars. Étude sur un cas de somnambulisme avec glossolalie. Par TH. FLOURNOY. Paris, F. Alcan, 1900. pp. xii, 420.

Under the above somewhat dramatic title we have a close, detailed and exhaustive study of a new case of automatism. The subject, known as Hélène Smith, is an unmarried woman of thirty years, strong, healthy, vigorous and, excepting the automatisms to be mentioned, presenting no apparent physical or mental abnormalities. She holds a responsible position as clerk in a mercantile house, and is of unimpeachable character. As a medium, she is unpaid and non-professional. She is not a spiritist nor member of any spiritist society, though she has steadfast faith in the objective character of her revelations. Her father was a talented linguist, the linguistic habit being inherited by Hélène only subconsciously, as primarily she has a distaste for languages, and knows only French. From her mother she inherited her disposition to automatism. As a young girl she led a subjective life, given to brooding, sadness, nervous fear, a feeling of estrangement, and an antagonism to her humble environment to which she felt herself superior. It is well to note also a kind of subjective inventive talent exhibited, for instance, in embroidery work in which her hands moved almost automatically.

Mlle. Smith's automatism did not begin until she was about twenty-

two years old, when she was initiated by some friends into certain table tipping seances. She proved an apt subject, her mediumship exhibiting itself at once in the triple form of visual and auditory hallucinations and typtological manifestations. Three years later Professor Flournoy made her acquaintance and began his long and patient study of the case. But from this time her automatism took a more intense form, including, in addition to those mentioned, various hypnoid phenomena, such as the profound trance, anæsthesias, disturbances of motility, catalepsy, emotional attacks and systematic confusion of the right and left sides of the body. Furthermore, between the regular seances, Hélène is subject at any time to visual and auditory hallucinations, irruptions of subliminal dreams and useful subconscious automatisms.

As regards the content of the communications, they fall into four groups or cycles, somewhat like four continued stories. These are the Hindoo cycle, the Royal cycle, the Martian cycle and the Leopold cycle. The latter, however, is different from the others, as Leopold figures to some extent in all of them and bears a relation to Mlle. Smith somewhat similar to that formerly existing between Dr. Phinuit and Mrs. Piper. The Hindoo and the Royal cycles are based upon the pretended reincarnation of a Hindoo princess first as Marie Antoinette, and finally as Hélène Smith. She was the daughter of an Arab sheik, and under the name of Simandini became the wife of the Hindoo prince Sivrouka Nayaca, who, in the year 1401, built the fortress of Tchandraguiri. This pre-existence she attempts to prove by writing and speaking Arabic and Sanskrit and recounting certain historical events relating to this obscure epoch. The Martian cycle is still more dramatic, and is psychologically the most interesting of all. In trance Hélène discovers herself floating upward through stellar space and arrives upon the planet Mars. She describes the Martian inhabitants, their dress, manners and houses, and draws pictures representing scenes upon that planet. She speaks and writes the Martian language, and finally consents to translate it, word for word, into French. It is a veritable language, inflected, and capable, apparently, of expressing any thought, and is understood by the medium in its fourfold form of a language spoken, heard, written and read. The Martian texts produced are innumerable in number. Many of them, with their translations, are reproduced by the author in the text, together with some of the drawings of Martian scenery. The following is a short specimen of the language: *Dé véchi ké ti éfi mervé éni*, meaning, word for word, *Tu vois que de choses superbes ici*. There is a special script for writing the language resembling hieroglyphics.

The author's critical analysis of these automatisms as psychological phenomena is of a very thorough and systematic kind. This is particularly noticeable in unraveling the mystery of the Martian language. There have been many instances of glossolalia, but it has probably never happened before that one of these "tongues" could be reduced to writing, translated and studied in such detail. Professor Flournoy has brought skill and patience to this task, and it is, perhaps, the most valuable part of the present work.

I can give but the barest summary of the author's conclusions, which he puts forward only as hypotheses, maintaining throughout the book the greatest impartiality towards all shades of opinion. The Martian romance is a subconscious dream suggested probably by Flammarion's work and the interest in spiritistic circles at that time in communicating with the inhabitants of other planets. It is a product of constructive imagination of an essentially infantile character bearing marks of a subjective origin throughout. The Martian language is a puerile modification of French, not made up in cold blood by Hélène,

but is the long continued pastime of a peculiar subconscious personality inheriting linguistic tastes and taking childish delight in these creative fancies. Difficult as this hypothesis seems in its application to the formation of so elaborate a language, nevertheless it is fully confirmed by an experiment which the author himself finally made. He bluntly informed the medium of his opinion of the language and produced incontestible proofs that it was only a modified French, whereupon there followed in future seances an attempt to modify the language and correct its too apparent faults, producing an *ultramartien* unlike any other language. This truly is mental vivisection, and one wonders whether subconscious personalities are capable of feeling pain and weariness!

The Hindoo romance presents some greater difficulties. The facts narrated are finally traced to a single obscure and (unfortunately for the medium) unreliable historian named Marlès, whose work Professor Flournoy's hypothesis makes it necessary that Hélène must at one time have seen, although he admits that that seems improbable. The Arabic is limited to a single phrase and the Sanskrit, although it contains many Sanskrit words and some phrases, is for the most part a jargon.

The chapter on the supranormal is a relatively short one. The author continues in his attitude of fairness towards all theories, exhibiting as great contempt for the bigoted devotee of "science" who has accepted the *a priori* impossibility of the supranormal, and has, therefore, no interest in psychic research, as for the credulous spiritist who detects the spirit of his great aunt in every joggle of a table. He even goes so far, perhaps somewhat to the American reader's surprise, as to affirm his faith in telepathy and the movement of objects without contact. He admits, however, only unsatisfactory evidence for these in the case of Hélène, while all the appearances of clairvoyance, lucidity, incarnations and spirit manifestations are explainable as hypnoid phenomena.

As an example of method this book is to be highly commended, and method is what is needed now in the study of automatism. Any one who should complain that the case of Mlle. Smith is not sufficiently "remarkable" to merit 420 pages of minute description fails to understand the importance of the study of secondary personality. The author's intimations of the infantile and reversionary character of the secondary personality are of interest in the light of recent theories.

University of Iowa. G. T. W. PATRICK.

RECENT NEUROLOGICAL LITERATURE.

By COLIN C. STEWART, Ph. D.

The Nervous System and its Constituent Neurones, designed for the use of practitioners of medicine and of students of medicine and psychology: by LEWELLYS F. BARKER, M. B., Associate Professor of Anatomy in the Johns Hopkins University; 2 colored plates and 676 illustrations, pages xxxii and 1122. New York, D. Appleton & Co., 1899.

Although perhaps too technical for the average reader, and lacking, to a certain extent in completeness when considered from the purely physiological side, Prof. Barker's book will remain for many years one of the readiest and most useful works upon the subject. Systematic arrangement, wealth of detail in every subdivision, and profuse and

well chosen illustration, are characteristics which point to the value of the book for reference purposes. Nor is the list exhausted, for we have, in addition to a classified table of contents, a subject index of twenty-six pages, and an index of authors comprising approximately 750 names. Of the illustrations, many of which are original, we have slightly more than one to every two pages of text. Most are in clear line drawing, many are in half-tone, and not a few are in colors.

The first section, of six chapters, is devoted to the development of the neurone concept—the name "neurone" being applied as meaning "a cell belonging to the nervous system, with all its parts." A full historical presentation is made, with the conclusion that the neurone theory is supported by all the facts at our disposal. Reported findings to the contrary are to be regarded as exceptions of relatively rare occurrence. As to the results of Apáthy's work, as yet incomplete, judgment is of necessity reserved.

Section II, with three chapters and 31 illustrations, is devoted to the external morphology of neurones. There is an interesting reference to some of Nissl's later work and his theory that much of the non-cellular cortical gray matter is composed of an interlacing of fine fibrils, resembling neuropil, and not altogether of the dendrites of cortical cells. To these Nissl would attach the highest importance. And this from the closing paragraph of the section: "The whole doctrine, by means of which sleep, anæsthesia, the phenomena of hysteria, double personality, etc., are to be explained by amœboid movements of the dendrites, or the so-called "retraction theory," appears to be based on the single observation of Wiedersheim. . . . The idea has been severely criticised by von Kölliker, and it is worthy of note that a theory so feebly supported by facts has been so widely accepted and made the basis of a mass of clinical generalizations."

The internal morphology of neurones is treated of in the third section, with five chapters and 26 figures. Conflicting views as to ultimate structure are reviewed at length, and many details of staining and technique are given. Chapter XIV is a summary in four pages of our present incomplete knowledge of the internal structure of nerve cells.

The origin of the nervous system in the embryo and the early development of cells and cell relations, with a chapter on segmentation and the mechanical factors of development, are the subjects of Section IV, with 55 illustrations.

The next section is devoted to the neurone as a unit in physiological and pathological processes. The normal metabolism of the nerve cell is followed by a chapter on the degeneration and regeneration of nerves, in which the facts, the literature, and the various methods of demonstrating degenerative changes are fully treated. Chapters XXI, XXII and XXIII discuss the irritability of the neurone and many closely related questions, of which a few are: spontaneity, transference of excitation, the specific energies of nerves, the conducting function of the cell body and the dendrites, and the direction of conduction. The next two chapters treat of the histological changes as the result of fatigue, the influence of a large number of poisons, the effects of anæmia, and of conditions leading to secondary degeneration.

These five sections bring us to page 312. The remainder of the work, Section VI, is devoted to the working out of the topography and relations of the various groups of neurones as they go to form the complex nervous system of man and the mammals. And it is in this latter part of the book especially that we are indebted to the writer for the laborious care with which facts have been drawn together and systematically arranged. The section covers nearly 800 pages, with, roughly, 500 illustrations; and in writing it anatomical, physiological, pathological, embryological, and histological material are fully made use of.

The various groups of neurones are described in order, illustrated both by explanatory diagrams and by reproductions and figures. The peripheral centripetal neurones,—the sensory neurones of the first order,—are considered first, with 70 figures of peripheral sensory endings other than those of special sense, and many others. Then come those centripetal neurones within the central nervous system which connect the end stations of the first group with higher and higher levels—neurones of the second and higher orders. Under this heading are described the tracts in the cord, medulla and higher parts, and the grouping of their cells in nuclei and centers. After the centripetal come the centrifugal neurones of the first order, those connecting the central nervous system with the voluntary muscles of the body; and the centrifugal neurones of higher order, placing the first under the control of higher parts. Under this, among other things, localization of function in motor areas is dealt with. And lastly, four chapters are devoted to the projection, commissural and association neurones of the telencephalon.

The only thing left to be desired is a fuller presentation of the structure and relations of the sympathetic neurones, but as a matter of fact that is not central nervous system, and after all we already have a series of excellent papers by Huber.

The total number of functional cells in the cerebral cortex of man, and the percentage of the total volume of the cortex composed of nerve cell bodies, calculated from Carl Hammarberg's data; together with a comparison of the number of giant cells with the number of pyramidal fibres. HELEN B. THOMPSON: Journ. of Compar. Neurol., IX, No. 2, 1899. pp. 113-140, 2 figs.

Following the method of dividing the cortex into sixteen structurally uniform areas, the author has placed the determination of the number of functional cortical cells at 9,200 million. Only 1.37% of the total volume of the cortex is composed of cells, and the number of giant cells is almost the same as the total number of pyramidal fibres.

A note on the significance of the small volume of the nerve cell bodies in the cerebral cortex in man. H. H. DONALDSON: Journ. of Compar. Neurol., IX, No. 2, 1899. pp. 141-150.

Though of the utmost physiological importance, small differences in the mass of nerve cell bodies must escape detection by the method of weighing, for the total weight of all the nerve cell bodies in the brain is less than 27 grammes. This is less than half the range of variation in weight in groups of brains classified according to sex, mental power, stature or age. Hence these differences must be mainly in growth of medullary substance.

The number and arrangement of the fibres forming the spinal nerves of the frog. I. HARDESTY: Jour. of Compar. Neurol., IX, No. 2, 1899, pp. 64–112; Plates VI to XIII.

The number of fibres decreases in the ventral spinal root from the cord to the ganglion, and in the dorsal root, both ways from the ganglion; the difference being in the number of small, and presumably growing, fibres. The sum of the fibres in the trunk and dorsal branches of a spinal nerve exceeds considerably, in every case, the sum of those in both dorsal and ventral roots combined. The method used by Hardesty is an interesting one. Microphotographs of cross sections of nerves stained in osmic acid were made, and in these photographs the fibres were cancelled by the same movement that clicked an automatic counter.

On some numerical comparisons of the centripetal and centrifugal medullated nerve fibres arising in the spinal ganglia of the mammal. H. H. DALE: Jour. of Physiol., XXV, No. 3, 1900, pp. 196–206; Plate II.

There are in the cat about 0.5 per cent. more fibres in the trunk of a spinal nerve than in the two roots combined, the excess being caused by fibres of small diameter, going probably from the gray ramus to supply the blood vessels or other tissues of the ganglion. The author does not agree with Hardesty in finding fibres arising from cells in the ganglion to end close to it; and concludes from his measurements that fibres of both ventral and dorsal roots taper slightly in size as they pass away from the cord.

Observations on the weight and length of the central nervous system and of the legs in frogs of different sizes (rana virescens brachycephala, Cope). H. H. DONALDSON, and D. M. SCHOEMAKER, Jour. of Comp. Neurol., X, No. 1, pp. 109-132.

The male of this species rarely exceeds 50 grammes in weight, while the female may reach 75 g. or over. The weight of the brain in the largest males is, however, less than that in females of comparable size. This is in direct opposition to the finding published by Fubini in 1881, for *rana esculenta* and *rana temporaria*. The authors have also found that the relative weight of the brain, as compared with that of the spinal cord, decreases as the frog increases in size. This fact makes it possible that more exact comparisons would be made if male frogs of any given weight were compared, not with females of the same size, but with those in the same relative position in the scale of their range of growth. A full grown male frog is probably not comparable with a female frog of the same weight.

In frogs of all sizes the sum of the lengths of the leg bones, and the proportional lengths of the several bones, are nearly constant. The weight of the leg muscles, compared with body weight, increases up to 5 g. in weight, then decreases slightly as the frog increases in size.

A contribution to the study of the pyramidal tract in the central nervous system of man. W. G. SPILLER: Brain, No. 88, Winter 1899, pp. 563-574.

The Marchi method was applied in a case of tumor in the internal capsule and lenticular nucleus. Besides observing the homolateral fibres running with the crossed pyramidal tract, the author describes a tract which separates itself from the pyramidal fibres to lie external to the olivary body on the side of the lesion, and on the periphery of the cord in the upper cervical region. These are interesting when compared with the antero-lateral descending fibres which degenerate in the monkey after cortical lesion.

Spinal cord changes in cases of cerebral tumor. F. E. BATTEN, and J. S. COLLIER: Brain, No. 88, Winter 1899, pp. 473-533.

An examination of a large number of cases of cerebral tumor has led to the conclusion that degeneration in the posterior columns, which occurs in about 65 per cent. of the cases, is of root origin, is independent of the nature or position of the tumor, and is caused by intracranial pressure, distension of the subarachnoid space of the spinal cord, with traction on the spinal roots.

Observations on the ascending tracts in the spinal cord of the human subject. E. E. LASLETT, and W. B. WARRINGTON: Brain, No. 88, Winter 1899, pp. 586-592.

Two human cases, one of caries with disintegration of the mid-dorsal

cord, one of injury and destruction of the cord at the 10th dorsal root, were examined by the method of Marchi. Degenerated fibres in the postero-median column end above in the nucleus gracilis. In one of the cases fibres of the 4th posterior spinal root, lying in the middle of the postero-external column, end below at the level of the 5th and 6th, and above in the nucleus cuneatus, with collaterals passing to the cells of the postero-lateral group. Some degenerated fibres cross from the anterior horn on that side through the anterior commissure—the "crossed afferent fibres" of Edinger. The dorsal cerebella tract is followed through the restiform body to the cerebellum, and the ventral cerebellar fibres, including some lying along the ventral fissure, to a position external to the inferior olive from which they pass to the superior medullary vellum. Beyond that point their course was not followed.

On the evidence of the Golgi methods for the theory of neuron retraction. (Abstract.) R. WEIL, and R. FRANK: Archives of Neur. and Psychopath., Vol. II, Nos. 3–4, 1899.

The authors have found, in a study of 342 preparations from 43 animals, using the Golgi method, rapid, mixed and slow, and Cox's modification, that normal material, as well as toxic, is as a rule free from varicosities when treated by the slow method, while the more rapid methods show them in corresponding richness. The results from the same material vary with the method, and constant results are not always obtained from the same material treated by the same method. The conclusion is that the varicosities are to be regarded as artifacts of the Golgi method.

NOTES.

Reading without Articulation.

In a reference to my paper upon the above topic (this *Journal*, Jan., 1900, pp. 225 ff.), Mr. H. H. Bawden writes in his monograph, "A Study of Lapses" (*Psych. Rev.*, Supplement 14, April, 1900), as follows:

"We question the accuracy of the introspection in the case of the subject who is reported by W. B. Secor as not dependent upon the articulatory imagery in reading. There is no doubt that this author's conclusion is correct when he says that practice brings the visual imagery into greater prominence, but that it is possible to 'grasp the meaning of printed or written matter through the eye alone without the aid of articulatory images' is open to grave question. The probability is that the kinæsthetic imagery has changed from a gross to a finer type, say, from the grapho- or articulo-kinæsthetic to the imagery connected with the finer movements of the eye, but that it vanishes entirely is *a priori* improbable and *a posteriori* undemonstrated."

It seems clear that Mr. Bawden has here confused two different questions. We do not articulate with our eyes, and the sensations from eye-movement can therefore hardly be termed articulatory. Whether these sensations actually replace and stand for the articulatory sensations, and whether the presence of some kinæsthetic factor is indispensable to meaning, are questions which we did not touch upon.

Our point was this. In the case of the subject cited, neither introspection nor the Verdin laryngograph gave, under certain conditions, any evidence whatsoever of the presence of articulatory imagery. Thinking that introspection might be at fault, we tried to devise methods for its control (pp. 232 f.); and we were careful to say that the laryngograph has its limits (p. 233). Mr. Bawden's criticism, therefore, simply mentions one of the two sources of error (the uncertainty of introspection) to which we ourselves called attention, and, as it happens, the one which we think was ruled out by our procedure. What is now wanted is work with other subjects, and more especially a more delicate form of laryngograph.

W. B. Secor.

Early Memories.

I wish to call the attention of such psychologists as may not yet have seen it to President Hall's paper in the *Pedagogical Seminary* for December, 1899, entitled "Note on Early Memories." The article is one of extreme interest, and arouses a very flood of introspective reminiscence in the reader. It is also of great importance from the genetic standpoint, and should receive careful criticism and consideration from workers in the genetic field.

I mention here two passages only, which show a welcome sameness of result from the fields of genetic and of structural psychology. On p. 512 the author says: "The act of recall itself has, I think, in every case had a certain unique kind of pleasure attaching to it." This tallies well with the laboratory verdict: "Every recognitive experience is intrinsically pleasant," (my *Outline of Psychology*, 1899,

p. 275). Again, we read (p. 486) of "things that brought a distinct sense of familiarity, but no trace of anything like memory;" *cf.* the discussion following, and especially the wild-rose bush incident on p. 489. All this agrees admirably with the laboratory analyses of 'reduced' recognition or direct apprehension (*Outline*, p. 278), and of organic memory (*Ibid.*, p. 293).

The value of work of this kind can hardly be overestimated. It emphasizes the oneness of psychology, by whatever method we approach the problems of mind.

E. B. T.

Fluctuation of Tones.

Mr. H. O. Cook found, in opposition to Dr. W. Heinrich, that liminal tonal stimuli show the intensive variations known as 'fluctuations of attention' (this *Journal*, October, 1899, pp. 119 ff.). Dr. Heinrich has just published a new investigation upon the subject (*De la constance de perception des tons purs à la limite d'audibilité*, in the *Bulletin international de l'academie des sciences de Cracovie*, Jan., 1900, pp. 37 ff.). He finds that pure tones (*i. e.*, tones free from all admixture of noise) do not fluctuate; the fluctuations in Mr. Cook's experiments were due to the presence of noises, "bruits à peine perceptibles."

Dr. Heinrich's result is surprising, in view of the introspective verdict that the tone, heard as tone, fluctuates. It must, however, be accepted as the last experimental work upon the subject. Meantime, we had ourselves planned (and have begun) a continuation of Mr. Cook's investigation, with purer tone sources. We shall return to the question as soon as a result, positive or negative, has been reached. It is needless to say that the issue is one of high theoretical importance.

E. B. T.

COMMUNICATION.

The following letter, written without thought of publication, is printed by the author's permission. It was the second addressed to the editor in response to a second urgent letter from him requesting a sitting with Mrs. Piper. It is printed here with the thought that it may interest and inform other psychologists who may seek interviews.

Boston, Mass., Feb. 24, 1900.

Dear Dr. Hall:

In reply to your further letter of Feb. 23rd, I fear that my previous letter, perhaps owing to its brevity, did not sufficiently explain the situation as regards Mrs. Piper. I shall describe it in further detail as it purports to be from the point of view of the communicators through Mrs. Piper's trance.

In the attempt to get proof of personal identity from the Rev. W. Stainton Moses, who died in 1893, I came into relation with certain intelligences that claimed to have been the chief spirit instructors of Stainton Moses for some years during his life time, and whom he called by the names *Imperator, Doctor, Rector*, etc. Imperator was alleged to be the leader and general supervisor in connection with the supernormal experiences of Stainton Moses, accounts of which will be found in the Proceedings S. P. R., Parts XXV and XXVII. Imperator, communicating through Mrs. Piper's trance, very soon claimed and assumed the supervision of the trances. I definitely agreed to this supervision. For a number of years prior to this time I practically

made such arrangements as I pleased as regards the introduction of fresh persons to sittings with Mrs. Piper. Imperator stated that it was impossible that the best work could be achieved from their side under such conditions, that Mrs. Piper's organism regarded as a machine had been "battered and worn," that it needed much repairing, that the utmost care must be taken as regards the persons introduced on the earthly side, and the persons allowed to use the machine from the so-called spirit side. For the purpose of securing proper conditions, Imperator claimed that they on their side could alone decide what persons should be allowed to communicate, as they alone could determine what conditions might be beneficial to, and what injurious to the machine. General experimenting by persons on this side was prohibited. Opportunities have been given for the introduction of fresh persons to the trance. These, however, have been few in number. The introduction of fresh persons at the present time has been absolutely prohibited. Imperator has stated that the conditions are such that it would interfere with the work which they have to do in improving the machine and in other matters if fresh sitters were now introduced. All this has been explicitly laid down without any doubt, and I am bound by my agreement.

This Imperator regime began at the latter part of January, 1897, and I refer you to section 7 of my report in Part XXXIII of our Proceedings, entitled "Recent Changes in Mrs. Piper's Trance," pp. 407–12.

During my year's absence in England, from September, 1897, to September, 1898, various fresh persons were allowed to have sittings besides a group of persons who were previously familiar with Mrs. Piper's trance. Later on, however, after my return here, a much closer restriction was exercised by Imperator. Only about half a dozen fresh persons were allowed to go at all during last season, and at the present time no fresh persons are allowed to be introduced.

I have had, I think, hundreds of applicants for sittings during the past year. I have had four new applications besides your own this week.

Several persons have had the opportunity of having sittings about once a fortnight, and Mrs. Piper goes into trance now usually only three times a week. It is probable that later on even this small group of persons will be restricted.

Briefly, once more then, the situation is that the matter at present is out of my direct control. I have agreed, so to speak, to let Imperator manage the machine. Absolutely explicit instructions have been laid down by Imperator that no persons shall be admitted to the sittings except as appointed by him. It is not likely that any fresh persons will be allowed to have sittings in the future at any time, except such as are in special grief for the recent loss of near friends or relatives.

As to the general wisdom of this management by Imperator, I have myself personally no doubt. It would, however, take me too long to explain my view of the situation at length in a letter. I refer you again to section 7 of my report in Part XXXIII for some suggestions in this direction, which I expect to work out more fully in later reports.

From my own point of view, Mrs. Piper's organism as a medium of communication from the other side to this represents an extremely delicate machine, which is likely to get out of order unless the utmost care is taken as regards the conditions. This is not realized by the ordinary person; and yet we know well that even in cases which are probably enormously less complex, absolute exclusion is necessary. There are, *e. g.*, machines used in physical experiments which are isolated in such a way that observers are not permitted to even enter

the room in which the machine is placed. And yet persons who are completely ignorant of the conditions, both general and special, under which the communications through Mrs. Piper come, actually feel aggrieved that they cannot in succession try their apprentice hands and the apprentice hands of their spirit friends at the working of such a complicated and delicate machine as Mrs. Piper's organism.

Yours sincerely,

R. HODGSON.

BOOKS RECEIVED.

CARPENTER, EDWARD. A visit to a Gñani. From Adams Peak to Elephanta. Alice B. Stockham & Co., Chicago. Price, $1.00.

CARUS, PAUL. The soul of man. An investigation of the facts of physiological and experimental psychology. 2d ed. With 182 illustrations and diagrams. Open Court Pub. Co., Chicago, 1900. pp. 482 (The Religion of Science Library, No. 41. Price, 75 cts.).

COE, GEORGE A. The spiritual life. Studies in the science of religion. Eaton & Mains, New York, 1900. pp. 279. Price, $1.00.

FOLKMAR, DANIEL. Leçons d'anthropologie philosophique. Ses applications à la morale positive. Schleicher Frères, Paris, 1900. pp. 336. Price, Fcs. 7.50.

FOUILLÉE, ALFRED. La france au point de vue moral. Félix Alcan, Paris, 1900. pp. 416. Price, Fcs. 7.50.

LEVY-BRUHL, L. La philosophie d'Auguste Comte. Félix Alcan, Paris, 1900. pp. 417. Price, Fcs. 7.50.

MONCALM, M. L' origine de la pensée et de la parole. Félix Alcan, Paris, 1900. pp. 316. Price, Fcs. 5.

ROYER, MADAME CLÉMENCE. La constitution du monde. Dynamique des atoms, Nouveau principes de philosophique naturelle. Schleicher Frères, Paris, 1900. pp. 800. Price, Fcs. 15.

SOLLIER, PAUL. Le problème de la mémoir. Essai de psycho-mecanique. Félix Alcan, Paris, 1900. pp. 218. Price, Fcs. 3.50.

STARBUCK, EDWIN D. The psychology of religion. An empirical study of the growth of religious consciousness. With a preface by Wm. James. Imported by Charles Scribner's Sons, New York, 1899. pp. 423. Price, $1.50.

SWEDENBORG, EMANUAL. On Tremulation. Translated from the photo-lithographed copy of the Swedish MS., by C. Th. Odhner. Massachusetts New-Church Union, Boston, 1899. pp. 79. Price, 50 cts.

TANON, L. L' évolution du droit et la conscience sociale. Félix Alcan, Paris, 1900. pp. 166. Price, Fcs. 2.50.

THILLY, FRANK. Introduction to ethics. Charles Scribner's Sons, New York, 1900. pp. 346. Price, $1.25.

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THE PSYCHOLOGY OF CONJURING DECEPTIONS.

By NORMAN TRIPLETT, Fellow in Psychology, Clark University.

This study is concerned with that portion of the field of magic which can be properly included under the term conjuring. For the purposes of this article, this may be broadly defined as the performance of wonderful or miraculous deeds of any sort under pretense of other than ordinary human agency. The subject will be treated in two parts. In the first chapter an effort is made, by the comparative method, to find in the deep lying instincts and impulses of the psychic life the basic elements in conjuring.

In the remaining portion of the work attention is given to modern conjuring. In the large body of existing conjuring tricks is found much material of value to the psychologist. Many of these are perfect psychological experiments whose efficiency have been proved on thousands of people. About the profession of prestidigitation, as of other occupations, there has grown up a body of special knowledge, in part formulated into rules and practices, of which it is here the purpose to show the psychological reason. The treatment of the subject will follow this outline:

1. Origin of Conjuring.
2. Classification and Typical Examples of Modern Conjuring Tricks.
3. The Training of the Conjurer.
4. Psychological Justification of the Rules and Practices of the Conjurer, treated under, (1.) Attention, (2.) Perception, (3.) Suggestion and Association, (4.) Suggestion and the Law of Economy.
5. Sociological and Pedagogical Observations.

I.

Origin of Conjuring.

In considering the elements of conjuring the view here advanced is (1.) that at bottom it rests upon a universal instinct to deception—a biological tendency appearing throughout the animal world from simple forms to the highest orders, which acts as a constant force in the process of natural selection—as a means of preserving the self or species. This instinct, blind enough at the beginning, and to be classed as a deception only by reason of its effect, in the higher orders becomes implicated with an ever-increasing intelligence, ending with the conscious deceptions of man, which in him, find their widest range and their highest form. (2.) In the struggle of primitive man to increase his personality conjuring came into existence. According to this view conjuring is deception ingrafted upon the religious instinct and thus given a supernatural coloring.

The Instinct to Deceive.

A division of all deceptions may be made into (1.) serious deceptions or those in which some form of selfishness appears, and (2.) deceptions of play. The group first named will be here noticed. Regarded biologically, these have in all cases as their common unifying principle that they serve, or have served in the past, the interests of the individual or species making use of them. From the psychological standpoint they are to be regarded as a manifestation of the instinctive struggle for power characteristic of every normal living organism—as an expression not only of the "will to live" but to live regnant.

A complete review of the materials in proof of such an instinct is here impossible. It will serve the end in view to cross-section the stream of these activities at different levels for purposes of illustration. In the search for beginnings of deception no need is felt of groping back of instinct to consider the play of chemical forces within the protoplasm; nor to seek in tropisms nor in any form of irritability of the cell the origin of the phenomenon. It is enough to state the view of Schneider[1] and others who would do so, that the tendency to withdraw from the unpleasant in simple cell life is the source of all the self-protective impulses and reactions which are later developed, including that of flight; and that the tendency to expand to the agreeable differentiates into impulses and instincts of an aggressive kind, as fighting and reproduction.

The facts of protective mimicry[2] are first to receive attention.

[1] Schneider, G. H.: Vierteljahrschaft für wiss. Phil., III, p. 297.

[2] For the subject of Mimicry, see Bates, Naturalist on the Amazons; Wallace, Natural Selection, and Poulton, The Colors of Animals.

Protective mimicry is the name given to a power of adaptation of form and color on the part of an animal species to that of its environment or to another species, which, from various reasons, as a disagreeable smell or nauseous taste, a sting or a hard integument, is immune from attack. Predaceous species, from which it is to the interest of the weak species to be concealed, are mimicked. On the other hand endless instances exist of predaceous insects being disguised to resemble their prey in shape and color. Indeed mimicry is universal among lower animals except in those cases where other means of defense exist. The reason for this as given by Darwin[1] is that they "cannot escape by flight from the larger animals which prey upon them, hence they are reduced like most weak creatures to trickery and dissimulation." Some small birds, reptiles and mammals which are weak in means of defense are also benefited by it. The Carnivores, also, which depend upon deceiving their prey, are nearly all colored to suit the enviroment.

From the standpoint of evolution the importance of this power of adaptation is obvious: thus a closer approximation of form and color to the copy, by giving a better means of escape or of securing food, assures to its possessor a corresponding advantage in the struggle. Modification in the direction of safety will, however, according to the law of parsimony, never be carried any further than is necessary to deceive the creature it is meant to deceive, but it must proceed that far else there is no protection. But what justification exists for calling the facts of mimicry deception? Premising that the word deception is not to be taken in animal activities with the same significance accorded to it in ethical discussions, but that it will connote more as we advance through the different grades of intelligence, it can be affirmed that the phenomena under discussion are in their effect real deceptions. "Naturally," Grant Allen[2] remarks, "there can be no mimicry without a creature to deceive; the very conception implies an external nervous system to be acted upon, and to be acted upon deceptively." Important as is the assumption of similarity in form and color in the animal making use of it, not less so from an evolutionary standpoint, is the group of associated habits developed to give it a proper stage setting and without which indeed the masquer would assume a vain role.

In the lower forms exhibiting mimicry the motor aspect is of a simple reflex type and the deception involved is unconscious. As Morgan[3] says, "Mimicry is biological not psychological." The Kollima butterfly, mentioned by Bates, whose

[1] Naturalist on Amazons. Letter to Bates. Memoirs.
[2] Grant Allen: Art. Mimicry, Encyc. Brit.
[3] Morgan C. Lloyd: In. Com. Psych., p 97.

folded wings exactly resemble dead leaves when alighting, feels the innate necessity of alighting only among dead leaves of its own color. So also the long green pipe-fish, with its prehensile tail, clings only to green seaweed, for only then is its color protective. So the green lizard seeks the grass and the brown lizard the sand. In these associated habits is found the basis for calling mimicry deception.

A group of phenomena of an apparently self-preservative character is the so-called death feigning of certain animals. Among those animals possessing the characteristic have been named, spiders, coleopters, caterpillars, snakes, turtles, fishes, numerous birds, and several mammals, among which are the monkeys, foxes, opossums, and possibly red squirrels. Hudson[1] says, "When a fox is caught in a trap or run down by dogs, he fights savagely at first, but by and by relaxes his efforts, drops on the ground and apparently yields up the ghost. The deception is so well carried out that dogs are constantly taken in by it, and no one not previously acquainted with the clever trick of nature, but would at once pronounce the creature dead. Now, when in this condition of feigning death, I am quite sure that the animal does not altogether lose consciousness. It is exceedingly difficult to discover any evidence of life in the opossum, but when one withdraws a little way from the feigning fox and watches him very attentively, a slight opening of the eye may be detected and, finally, when left to himself, he does not recover and start up like an animal that has been stunned, but slowly and cautiously raises his head first, and only gets up when his foes are at a safe distance." He states that in some cases the swoon comes on before the animal has been touched.

Without going into the merits of the controversy which is still unsettled, as to whether the activity in question is of a cataleptic nature as Couch, Preyer, and others maintain, or is a true manifestation of instinct, the writer inclines to the latter side of the case. From all the data at hand the trait under discussion appears to be a serious stratagem evolved to serve a useful end. Among those holding this view is Lloyd Morgan,[2] who thinks the collapse of extreme dread has its protective value in the case of animals that sham dead and that it has been organized through natural selection into an instinctive response of stillness and limpness and that "the same stimulus may give rise at the same time to instinctive reactions and to the visceral reaction essential to emotion, the two inseparably connected in origin. The result is that the instinctive data and emotional data are simultaneously presented to consciousness and their association is of the closest possible nature. With

[1] Hudson, W. H.: The Naturalist in La Platte, p. 202.
[2] Morgan: Habit and Instinct, p. 206.

the growth of experience this constant association is yet further strengthend and the motor and visceral effects are yet further consolidated, so that each tends to supplement and re-enforce the other."

A group of deceptions serving for the protection of the species is to be observed in the case of many creatures not sufficiently strong to fight off enemies. It is a well known trait of certain birds to flutter off the nest when disturbed and by simulating a broken wing to draw the intruder away from the eggs or young, flying away when at a safe distance with no pretense of lameness. "Such tactics," Lloyd Morgan[1] remarks, "are not restricted to one or two species. They are common, no doubt, with diversities of detail to such different birds as grouse, pigeons, lapwings, rails, avocets, pipets, ducks, buntings and warblers." Among American birds the habit has been observed in the case of several species of the partridge family, doves, vesper sparrows, whippoorwills, bobolinks, the plovers, rails, and allied species. The simulation of helplessness is a perfect device, at least so far as dogs are concerned. They seem never to get too old or too wise to start a pursuit. The impulse to react at sight of the fluttering bird is too strong to be resisted. Many ingenious variations of this instinct exist among other species. Clever ruses are also employed by many to conceal the nest. The care of the turkey hen to hide her nest and the various artifices she employs to throw a watcher off the clue, no one knows better than the farmer's boy who has been set the task of tracing her to the nest.

Wild animals, whose very existence hangs on the continued exercise of craft or strategic skill, can be cited endlessly in illustration of the fact that the battle is not always to the strong, but that life is very largely a war of wits. Everywhere we see the cunning devices used in attack and the counter devices of escape. They but emphasize the general fact that these deceptions are not sporadic cases; special developments for the protection of a few species making use of them. A deeper insight into the underlying forces maintaining the equilibrium in the vast complexus of animal life must be gained before a positive statement is warranted, but from the fact that they are the normal reaction of most animals under conditions tending to lessen well-being, or safety, it seems not too hypothetical to say that the impulse to deceive is a general expression of a biological principle existing throughout the animal world, and that it is a very large factor in the push upward.

Domesticated animals have all preserved this tendency to fall back on deception when comfort is threatened, as several hun-

[1] *Ibid.*

dred observations which the writer has gathered show. On a census of these the dog seems, from the number and versatility of its tricks, to be the chief trickster in the animal world, probably because he is most open to observations of this sort.

Popularly it is thought that the dog in many cases is guilty of conscious deception. While it is, perhaps, safer on the whole, to explain, as Morgan[1] does, most of the observed deceptions as due to associations formed in sense-experience, it is, nevertheless, only fair to leave the judgment unexpressed regarding a large number of instances seeming to show a conscious intent to deceive. It is not so easy to believe there is no actual deception in cases like this described by Groos.[2] He says: "I once saw one (dog) drop a piece of bread that he would not eat on the ground and lie down on it, then with an air of great innocence pretend to be looking for it."

From a summary of more than one hundred cases of canine craft the only point here emphasized is the fact of their selfish content. In families where the dog-churn was used, it was common for the motive power to absent himself early on the morning of churning day and hide out till night. To avoid being put out at night dogs and cats also will frequently hide in a dark room or behind furniture as the regular time approaches. They conceal themselves, also, to avoid baths or anything unpleasant. If unwilling to chase a cat that has given him proof of her prowess, or to do any distasteful task, the dog makes a great pretense of not knowing what is desired of him, but he assumes an anxiety to know; when spoken to sharply, however, he goes with a conscious guilty air and does what is required of him. When an old dog has been roughly used in play by a boy, or when busy with his bone or aware that he is to be shut up or sent after the cows or punished, he makes use of the childish resource of pretending not to hear. Often when caught in *flagrante delicto* the dog employs various means of avoiding chastisement. A terrier of superior intelligence, owned by the writer, at such times tried to change the subject by assuming a mood of frolicksome gaiety and executing a series of comical antics calculated to give a suggestion of amity. Frequently when scolded, like the King Charles spaniel cited by Romanes, the dog pretends to be very lame or in great pain. This dodge is especially tried where he has gained sympathy from a former wound. Lameness is also feigned by dogs wishing to ride in a vehicle, as it is by children wishing to be carried.

Many of these tricks of the dog and other domesticated animals seem far removed from the instinctive deceptions of wild

[1] Morgan C. Lloyd: In. Com. Psych., p. 371.
[2] Groos: The Play of Animals, p. 297.

animals. The essence of the act, however, appears to be the same, being an effort to better adapt themselves to their surroundings to increase their own comfort or pleasure, and, as such, are surely based on the old tendencies brought down from a former wild state.

If the statement that in some one of the lower animals may be found the germ of every human faculty is correct, then it seems not unreasonable to expect that activities so general and so important, as those just described, will have large place in the higher realm of life, or plainly that human deceptions will be found to possess the same instinctive character.

Deceptions in Children.

Of a collection of more than three hundred observations of spontaneous fooling or deceiving by children, a large majority were found to relate to children under three years of age. The cases exhibit an almost half and half ratio between the rubrics of spontaneous play activity and deceitful acts which involve an element of selfishness. A study of the latter group shows clearly the kinship existing between animal and child life. Children instinctively make the same responses to conditions affecting their pleasure or well-being, oftentimes in the identical form. Numerous cases show the use that is made of the "ostrich trick." "A little girl, past one year old, continued to chew paper whenever she could get it, notwithstanding her punishment. She used to stand up with her face to the wall chewing paper, evidently thinking because she saw no one, no one saw her, for if any one came and turned her around she would try to hide the paper which was left." Another forbidden to eat green fruit "lay down by the fence with the pear under her, perhaps thinking she would escape observation." This trait appears in various forms, and precedes real hiding which comes later. Shutting the eyes is common, holding the hand or an article before the eyes, and hiding the face in some one's lap or shoulder. Babies when frightened or diffident, or sometimes when scolded, hide the face on the mother's shoulder. So when tickled the face is hidden or eyes closed possibly as a means of escape from the annoyance. It is well known that sensitive dogs when scolded will hide their eyes in their paws or close them, and it may be for the same reason.

It is hard to analyze the action, but it seems evident tha to the child the world comes and goes at will with the opening or shutting of the eyes. When he shuts his eyes he makes it dark, so that no one can see. This limiting reality to the range of his own vision may become the basis of various attempts at deception. This resource is employed to escape punishment for a fault, as in the instance where a child had cut the

table cloth into strips: "when her mother discovered her she threw the shears down and covered her head with her arms." In clashes of personality, where children do not wish to be compelled to drop what they are engaged in, or to comply with distasteful commands, where censure is expected, and in many similar cases they refuse to answer when called or they hide.

Fear of punishment is the motive for the invention of many lies and acts of deceit, as most persons can testify, who will run back in memory over the events of their childhood. Some children committing a fault resort to tactics similar to those of the dog mentioned above. They take to kissing and caressing. Pretended illness often follows the doing of an act for which punishment is expected, though doubtless in the case of sensitive children it may at times become real enough. Where there is a desire to enlist sympathy or attract attention, or where pleasant remedies, such as wintergreen are used, this pretense is common. Later if school life is disliked, the child makes a great pretense of being ill, but will still be able to play around all day. On this point Dr. Hall[1] remarks: "The long list of headaches, nosebleeds, stomachaches, etc., feigned to get out of or to avoid going to school, of false excuses for absences and tardiness, the teacher especially, if disliked, being so often exceptionally fair game for all the arts of deception, all this seems generally prevalent. This class of lies ease children over so many hard places in life and are convenient covers for weakness and even vice." With school age the child enters upon a new life. He begins a struggle with social forces before unknown to him. His mental activities now find a wider scope and a fuller development, and along with a growing intelligence the deceptions become more complex, though still plainly of the same instinctive character. They are in all essential respects the same as those of animals and young children. They are the outgrowths of impulses directly or indirectly self-preservative and to go no further back, are doubtless reminiscent of man's life in past ages when chiefly by his nimble wit he could survive in the war of all against all.

There is little need to follow these deceptions up to their adult form. They crop out in every phase of our community life as a manifestation of the instinct to gain power or wealth and all that they make possible, and if indeed the present shows this tendency in an unusual degree, as Mantagazza[2] and others assert, it is because the conditions of life are becoming more difficult and by reason of the sterner competition are forcing

[1] Hall, G. S.: Children's Lies. *Am. Jour. Psych.*, Vol. III, No. 1.
[2] Mantagazza: The Tartuffian Age. Nordau: Die Luegen.

man to rely to a greater extent upon those innate animal impulses which the canons of morality among civilized races condemn.

Our commercial life is redolent of fraud from our gigantic infant industries with their specious pleas of inability to compete with foreigners, to the small grocer who is made by Puck to ask the clerk if he has sanded the sugar, larded the butter, and gravelled the coffee, and on being answered in the affirmative tells him to come into prayers. The political corruption in our large cities, the peculiar methods by which United States senators frequently gain their seats, and even the struggle for supremacy or survival between nations—not always carried on by force in the field, but by crafty diplomats intriguing behind closed doors to form combinations against the peace and prosperity of their neighbors—all this is commonplace. Yet a large view of these deceptions as of the others presented justifies the assertion, that they are of a piece throughout.

Relation of Deception to Conjuring.

The statement was made on a previous page that conjuring is based on two atavistic tendencies: The one which appears in nature as a general instinct to deceive has been sufficiently set forth. It yet remains to establish the other assertion, which was in effect, that primitive conjuring was the deceptive performances of priests become miracle by the religious superstitions of a deluded people.

The evolution of the sacred conjurer is made possible by the animistic tendencies of all savage peoples, among whom is developed a belief in spiritual beings of an elementary sort inhabiting stones, trees, animals or men. Extraordinary powers of body or mind in an individual, are due to an incarnate spirit—an ancestral ghost. Hence, arises the general doctrine of inspiration. Existing primitive races still believe that the priest when inspired ceases to act or speak as a voluntary agent, but moves and speaks as entirely under supernatural influence. From inspiration to divination is but a short step. It is simply the inspired man using his power for particular ends. His power as an exorcist arises from the belief that the priest by the aid of good spirits may eject the spirit of an enemy which has entered a man's body. This power proves available for other purposes. He asks why not revenge himself on enemies or invoke the spirit's aid in other matters of advantage to himself? There is thus initiated sorcery[1] and thaumaturgy.

Up to what stage self-deception is an element in religious conjuring it is not easy to say. That it should be present to some

[1] Herbert Spencer: Data of Sociology, Vol. I, Chap. 18.

degree among modern savages is not surprising when regard is had to the means of attaining to the office of priest. This, among nearly all savage peoples, is gained through the practice of some form of shamanism. This state may be brought on by fasting, the use of drugs, whirling, dancing, singing, beating drums or other means of producing abnormal excitement—the condition of inspiration. Since, however, it is also the "*mise en scene*" for the innumerable deceptions practiced upon their deluded followers, there must, in general, grow up a very large element of conscious fraud; but where self-deception leaves off and concious deception begins it is impossible to distinguish.

The psychological reasons impelling to priestly conjuring are all those motivated by the struggle for power anywhere. Power permits of revenge; it brings wealth and a host of euphoriac concomitants, such as pride of position, reverence, homage, praise and other elements tending to exalt personality. That it is a means to wealth is seen in many tribes of the present day. "Among the Zulus[1] the spirit doctors discharge a sacerdotal function, offering up sacrifices for which their mercenary spirit leads them to demand good pay. "These crafty izanusi do not go into Hades (when giving oracles) for nothing. A large fat ox is generally the reward and often a goat beside." Tylor,[2] speaking of the priest as conjurer in connection with ceremonial ordinances says: "more usually it is the priest who as minister of the deities has the lion's share of the offering or the sole privilege of consuming them; from the Figian priest who watches for the turtle and puddings apportioned to his god; and the West African priest who carries the allowances of food sent to the local spirits of mountain, or river or grove, which food he eats himself as the river's proxy, to the Brahmin who receives for the divine ancestor the oblation of a worshipper who has no sacred fire to consume it. 'For there is no difference between the fire and a Brahman, such is the judgment declared by them who know the Veda.'" Among the Andaman[3] Islanders "the priest inculcates the belief that he can bring sickness or death upon those who fail to show their belief in him in some substantial form." In Australia[4] the business is profitably worked by one sorcerer charming bits of quartz into the victim's body so that another has to be sent for to get them out. This imposture is interesting because in various forms it is common in nearly all parts of the world. The articles generally extracted are bones, bits of wood, stones, lizards and balls of hair.

Besides its material benefits the calling of the conjurer min-

[1] Tyler J.: "Forty Years among the Zulus," p, 100.
[2] Tylor: Primitive Culture, Vol. II, p. 379.
[3] Man, E. H.: Aboriginal Inhabitants of the Andaman Islands.
[4] Grey's Journal of Travel, Vol. II, p. 337.

isters to his self-importance. With all this priestly class there appears a love of showing off and filling the public eye, just as with the Flagellants who pretended to lash the blood from their own backs, or of the Fakirs of India who are such because of the distinction it gives them. Self-advertising is not the least of the conjurer's gifts whether ancient or modern. There is apparently, much more in the priests' impudent assertion of power than in their actual manifestation of it, as many of their feats are exceedingly trivial. But like every act of deception they seem to contain a pleasureable element. It may be true as Groos[1] says it is of all animal play that the pleasure is in satisfying an instinct and in being a cause. The evidence for the pleasure in modern conjuring is not hard to find. Robert Houdin constantly refers to its fascination. It has been said of Hermann that he was never so happy as when he went to orphan asylums or about the streets playing his tricks on children, policemen and shopkeepers. Kellar also assures the writer that his profession possesses an intense fascination for him.

Among the people of remotest antiquity the most unique deceptions the meager history of the times reveals are those performed under the guise of religion. Priestcraft and thaumaturgy, the first including the second, always held in view one great end: namely, the acquisition of power, veneration and obedience. To its attainment no scruple was permitted to restrict the means. All the resources of legerdemain, cabalistic rites and imposture of every sort were employed, besides natural phenomena and the facts of true science. All were given a semblance of the supernatural and were invested with an inviolable secrecy maintained by the use of a particular language, figurative expressions, emblems and allegories, and a dramatic setting such as the construction of their temples made possible. All combining to form a veil of mystery and acting powerfully to paralyze the critical faculty of minds not too acute in that naïve age.

The priests of antiquity were the conservators of learning. They alone possessed the highest knowledge, zealously preserved from profanation in the service of the gods by an impenetrable mystery. Indeed, it is only in comparatively recent times that knowledge has been allowed to filter out to the common people. Even Pythagoras and Plato did not believe in the fitness of the vulgar to receive truth. The priests exploited the secrets of science for a thousand years, at least, to maintain their religion and their own power. In the Christian era, on the contrary, as Andrew D. White[2] has shown, for

[1] Groos: Play of Animals.
[2] White, Andrew D.: Warfare of Science and Religion.

fifteen hundred years science was completely smothered by the antagonism of the church and regarded as sorcery.

The preliminary chapters of a history of the sciences must show their magical origin; while a history of old forms of thaumaturgical art, on the other hand, is a history of the origin of science. And not the least interesting fact connected with either is in showing how arts which come into common use may pass for divination and magic so long as the secret of their operation is the knowledge of but a few individuals. The oldest traces of magic are found in the records of Egypt, Chaldea and Babylonia. Among these nations sorcery and magical astrology are as old as their history. Astrology is well called the mother of science, for while it is true that the Chaldeans studied the stars for purposes of conjuration, their observations led to the science of astronomy. Medicine is also discovered to have had a magical origin. According to Sprengel,[1] "The highest healing power which acts not through palpable means, but by the aid of the will, was practiced by the priests of the highest rank; they were the soothsayers and sages, and knew how to produce many supernatural effects." They declared that the means to be used and the issue were revealed through prophecies. "In Egypt, more than in any other country, we find that physic is connected with religion and the priesthood."

Some of the positive sciences had their birth in the temples of the ancient religions. The miracles performed during the initiatory rites of the sacred mysteries are to be explained as physical and chemical effects. From descriptions which have come down to us of the phantasmagorial procession of the divinities we can easily discern the use of the principles of optics. Sir David Brewster[2] says on this subject that there can be little doubt that the concave mirror was the principal instrument used in connection with the pretended apparitions of the gods and goddesses in the ancient temples. In the scanty references to these apparitions which we possess is clearly seen the traces of an optical illusion. Pliny mentions that in the ancient temples of Hercules at Tyre there was a certain seat made of a consecrated stone "from which the gods arose." Æsculapius was often exhibited to his worshippers in his temple at Ephesus in a similar manner. Jamblicus tells us that the priests showed the gods to the people in the midst of smoke, the smoke evidently serving as a background on which to project the reflected images.[3]

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[1] Sprengel: Geschichte der Arzneikunde, Vol. I, p. 71.

[2] Brewster: Letters on Natural Magic.

[3] For the reference to this phase of Magic see Ennemoser, History of Magic; Lenormant, Chaldean Magic and Sorcery; White, Andrew D., Warfare of Religion and Science; Lehman, A., Aberglaube und Zau-

The science of acoustics also furnished the ancient sorcerers with some of their best effects. The imitation of thunder in some of their subterranean temples could not fail to indicate the presence of a supernatural agent. The golden virgins whose voices resounded through the temple of Delphos; the stone from the river Pactolus whose trumpet notes scared the robbers from the treasure which it guarded; the speaking-head which uttered its oracular responses at Lesbos; and the vocal statue of Memnon, which began at the break of day to accost the rising sun; the statues of the gods and the walls near them, discovered by explorers, possessing secret passages by which the priests could enter to deliver the oracles, are a few cases of this sort.

The principles of hydrostatics also were available in the work of magical deception. The marvellous fountain which Pliny describes in the Island of Andros as discharging wine for seven days and water during the rest of the year; the spring of oil which broke out in Rome to welcome the return of Augustus from the Sicilian war; the three empty urns which filled themselves with wine at the annual feast of Bacchus in the city of Elis; the weeping statues and the perpetual lamps of the ancients, were all the obvious effects of the principle of the equilibrium and pressure of fluids.

Chemical agents seem to have been used, if ancient literature is to be relied on for information. We recall the vengeance wreaked by Medea by means of her chemical jacket. Many examples of self-kindling altars are given, the explanation of which, as advanced by Salverte,[1] is that a petroleum or naphtha product was used, such as is still found in certain regions of that country. The apparent miracle which was worked in the sanctuary at Gnotia, where the incense kindled of itself in honor of the gods, and of which Horace and Pliny are so incredulous, was a feat easily to be compassed by the priestly jugglers.

A similar explanation will serve for the cases observed by Pausanius in two cities of Lydia, the inhabitants of which, subjected to the yoke of the Persians had embraced the religion of the Magi. "In a chapel," he says, "is an altar upon which there are always ashes that in color do not resemble any others. The Magi placed some wood upon the altar and invoked I know not what gods by orisons taken from a book written in a barbarous language unknown to the Greeks. The wood soon ignited of itself without fire and the flame of it was very brilliant."

We have now finished the portion of this study specially devoted to the serious deceptions of conjuring. Under various

berei; Frost, Lives of the Conjurers; and Hopkins, Magic and Stage Illusions.

[1] Salverte, E.: The Occult Science, etc.

forms not always distinctly religious, except in so far as all superstition is akin to religion, they continue down to the middle ages. Indeed history reveals how the destinies of a nation were in more than one instance subject to the scheming of a conjurer in the king's closet. They are in evidence in the performances of the latter part of that strange romantic eighteenth century of skepticism and credulity when the rotten fabric of French society was about to crumble under the storm of revolution. The society of the time, with overwrought imagination, hungering for miracles, offered themselves to every impostor as ready victims. Charles Kingsley says that this period "which is usually held to be the most materialistic of epochs, was, in fact, a most spiritualistic one." Imbert Saint Amand,[1] says "The mania for the supernatural, the rage for the marvellous, prevailed in the last years of the eighteenth century which had wantonly derided every sacred thing. Never were the Rosicrucians, the adepts, sorcerers, and prophets so numerous, and so respected. Serious and educated men, magistrates, courtiers, declared themselves eye-witnesses of alleged miracles. When Cagliostro came to France he found the ground prepared for his magical operations. A society eager for distractions, and emotions, indulged to every form of extravagance necessarily welcomed such a man and hailed him as its guide." Cagliostro was the last great pretender to magic and sorcery, and also the forerunner of our modern spirit mediums, who exhibit a phase of deception which will be noticed to some extent in the second part of this study which deals with modern conjuring. He raised the shades of the illustrious dead, told fortunes, predicted lucky numbers in the lottery, transmuted metals, and founded occult lodges of Egyptian masonry for the regeneration of mankind. He manufactured elixirs of life, and reaped an abundant harvest by professing the art of making old people young. He pretended to be of great age; saw Rome burned under Nero, and witnessed the crucifixion of Christ.

II.

Modern Conjuring.

Modern conjuring is motivated in large part by the same elements appearing in other play. It is doing for entertainment what once was regarded as serious miracle. This is true, however, only of conjuring proper. The shows of the spiritualistic mediums are still as of old deceptions of a serious nature.

The history of conjuring for entertainment takes us back at least to the middle ages where jugglers in connection with

[1] Saint Amand, Imbert: Marie Antoinette and the End of the Old Régime.

their acts of skill exhibited many curious feats at fairs and on the streets. During the eighteenth century the conjurers came into greater estimation with the public, and gave performances from the stage, while the jugglers were left to an itinerant and more obscure life.

Many of the pieces of modern performers were presented by the wizards of the last century. Sechel's print of Bartholomew Fair for 1732 shows Falkes to have been the great conjurer of the time. He exhibited among other things the now famous "flower trick" of the Indian conjurers. A swarm of conjurers during the last half of the century strove for recognition. One of this fraternity described by Cowper was Katterfelto "with his hair on end at his own wonders, wondering for his bread." They dealt largely in feats of dexterity with cards, numbers, dice, rings, etc., and also found profit in the exhibition of automata. A new epoch began with Pinetti, 1783. His tricks were invented by him, and from that time until Houdin came upon the stage, false bottom tricks, of which there were above forty, were much in vogue. The greatest reform in the art of conjuring was effected by the genius of Robert Houdin. Whatever advancement has been made since his time has been along the lines laid down by him, and are largely the result of the growth of science. Prior to his day the wizards draped their tables to the floor, making of them hiding places for confederates. He used an undraped center table, and two light stands at the sides. He discarded the long flowing robes of his predecessors and appeared in evening dress. Since his time no first-class performer has dared to return to the former mode.

Classification of Conjuring Deceptions.

The plan employed in the classification of the tricks is taken from the standpoint of the performer, having regard to the means used in working the illusion. A grouping according to the psychical processes involved was not possible for the reason that somewhat the same elements entered into a majority of the illusions. A strict psychological classification that suggested itself as possible was a division into (1) Positive illusions—in which the spectator believes he sees something which does not take place—an example of which is the thrown card disappearing in the air. (2) Negative illusions, or those feats in which the changes are made but are unseen by the spectator. The division would have no practical value as all but a very small number are found in the second division.

The list presented is not exhaustive but contains the majority of the better known illusions, and at least is sufficient to represent the different classes. Nothing more is claimed for it. It is apparent that many tricks could be classified under several

heads; in general, however, their place was determined by the most predominant feature.[1]

Tricks Involving Scientific Principles.

Optical Illusions. 1-234. Modern Black Art. 2-55. Cabaret du Néant or Tavern of the Dead. 2-61. Amphitrite. 2-63. The Mystery of Dr. Lynn. 2-81. Houdin's Magic Cabinet. 2-520. Gone. 5-60. Maid of Athens. 6-31. Denstone's Metempsychosis. 7-136. The Mermaid's Head. 2-60. The Three-headed Woman. 2-69. The Talking Head. 2-69. The Living Half-woman. 2-72. She. 2-79. The Queen of Flowers. 2-77. The Decapitated Princess. Stella, a variant of above. 2-84. The Mystic Maze. 2-86. The Platinized Glass Illusion. 2-88. Marguerite and Faust. 5-21. The Vanished Mirror and Spectral Demon. 5-32. Birth of Venus. 5-49. The Water and Ink Trick. 5-50. Valensin's Fish-bowl Trick. 5-5. The Blackboard Feat. 2-523. The Spider and the Fly. 7-46. Spirit Medium Reading Question by Means of Mirrors. 9-53. The Cards Revealed by the Looking-glass.

Acoustics. 2-102. The Invisible Woman. 2-103. The Magic Harps. 5-30. The Spirit Bell. 4-91. Poe's Raven in the Garland of Thebes. 4-36. Kellar's New Karmos. 2-170. Animated Puppets. 9-222. The Mesmerized Watch. 9-159. A coin being spun upon the table to tell blindfold whether it falls head or tail upwards.

Electrical. 7-62. The Educated Fly. 7-77. Spirit Telegraphy. 2-96. The Neo-occultism. 2-100. The Mask of Balsamo. 3-109. The Obedient Padlock. 3-114. The Demon Candlesticks. 3-122. The Spiritualistic Cash Box. 3-130. The Magic Clock. 3-135. Spirit Chirography. 9-483. The Light and Heavy Chest. 9-485. Spirit Rapping, The Magic Bell, The Magic Drum and many variations.

Chemical. 3-71. The Enchanted Sun Glass. 3-79. The Mysterious Goblet. 3-87. The Miniature Inferno. 3-98. The Strange Disappearance. 2-108 The Magic Rosebush. 7-7. Invisible Writing Brought out on a Single Slate. 7-11. Spirit Writing. 7-43. The Caustic Pencil Trick. 7-49. Spirit Writing on Held Slate. 7-51. Reading Questions in Sealed Envelopes. 7-132. The Mysterious Vase. 5-37. Blood and Water Trick. 5-39. Wine, Ink and Blueing Trick. 2-134. The Wine Changed to Water. 5-8. Transmigration of Smoke. 4-30. Spirit Pictures. 5-34. A Spirit Vision. 5-57. The Flash of Flame. 5-58. Balloon Production.

Mechanical Tricks (many of them with sleight of hand features). 1-149. The Magic Card Bottle. 1-152. All Nations in one Bottle. 1-208. The Magi's Wand. 1-230. The Indian Mail. 1-245. The Enchanted Organ. 1-261. The Cocoon. 2-27. Vanity Fair. 2-31. After the Flood. 2-34. The Magic Palanquin. 2-35. Cassadoga Propaganda. 2-39. The Appearing and Disappearing Lady. 2-44. The Mysterious Trunk. 2-46. The Indian Basket Trick. 2-89. Trilby. 2-91. The "Haunted Swing." 2-136. The Sand Frame Trick. 2-137. Houdin's Magic Ball. 2-367. Psycho. Mechanical Chess-player. 2-369. The Kempelen Chess Player. 2-374. The Juggling Automaton. 2-376. The Toy Artist.

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[1] In the classification the first number given refers to the book, and the second to the page where found. No. 1. Burlingame, "Hermann, the Magician." No. 2. Hopkins, "Magic, Stage Illusions and Scientific Diversions." No. 3. Hopkins, "The Twentieth Century Magic." Nos. 4, 5 and 6. Burlingame, "Tricks of Magic" in three vols. No. 7. Robinson, "Spirit Slate-writing." No. 8. "Revelations of a Spirit Medium." No. 9. Hoffmann, "Modern Magic," No. 10. Hoffmann, "More Magic."

2-519. The Magic Table. 3-29. The Flight of the Timepieces. 3-47. The Magical Balance. 3-56. The Salem Seamstress. 4-6. Mephisto's Glass Cylinder. 4-14. Ice Freezing Extraordinary. 4-18. The Magnetized Chair. 4-29. The Mystery of L'Hassa. 4-31. Shrine of Koomra Sami. 4-34. Great Mahatma Miracle. 4-81. The Mango Tree Trick. 4-85. Rapid Transit. 4-87. The Oriental Barrel Mystery. 4-87. The Artist's Dream. 4-92. Samuel's Cartomantic Floral Charm. 4-92. Flowers Transformed. 5-8. Instantaneous Flower Production. 5-29. Magical Appearance of Bouquet. 5-30. The Changing Cards. 5-33. The Magical Monk. 5-33. Artistic Metagenesis. 5-34. Fortune Telling Coin Tumbler. 5-35. Another Artist's Dream. 5-39. Flowers of Yaggi. 5-40. Egyptian Incubator. 5-42. Box and Die Trick. 5-50. Apple and Orange Trick. 5-51. Comical Box. 5-53. Flowers from a Cone. 5-54. Inexhaustible Box. 5-62. Vivisection. 6-1. Buatier's Human Cage. 6-11. Maskelyne's Spiritualistic Couch. 6-19. The Climbing Ring. 7-53. To Answer Questions Written and Kept in Pocket. 7-74. Houdin's Floating Piano and Performer. 7-101. Horatio Eddy's Light Seance. 7-110. The Wire Cage Test. 7-143. Cupid Lighter Than a Butterfly. 9-139. Tricks Performed by Means of the Changing Card Boxes. 9-187. The Vanishing Coin Box, The Rattle Box, and many others on the false bottom principle. 9-195. Lamouchoir du Diable. 9-202. The Miraculous Casket. 9-203. The Coin Wand. 9-215. The Watch Mortar and the Magic Pistol. 9-217. The Snuff Box Vase. 9-220. The Watch Target. 9-234. The Magic Rose. 9-246. The Burning Globe. 9-258. The Magic Laundry. 9-296. The Red and Black Ball Vase Vanish, many variants. 9-330. The Pillars of Solomon. 9-333. The Magic Coffin. 9-335. The Bran and Orange Trick. 9-337. The Rice, Cone, and Orange Trick. 9-342. The Magic Mill. 9-372. The Bowl of Ink Changed to Clear Water. 9-373. The Inexhaustible Bottle. 9-377. The New Pyramids of Egypt. 0-380. The Box of Bran Transformed to a Bottle of Wine. 9-385. To Fire Borrowed Rings from a Pistol and Make Them Pass into a Goblet filled with Bran, the Bran disappearing and being found elsewhere. 9-388. The Coffee Trick. 9-400. The Rose in a Glass Vase. 9-424. The Vanishing Canary Bird and Cage. 9-435. The Passee-Passee Trick. 9-454. The Fairy Star and the Card Bouquet. 9-458. The Demon's Head. 9-462. The Magic Picture Frame. 9-467. The Magic Picture and the Chosen Cards. 9-468. The Magic Portfolio. 9-469. The Glove Column. 9-539. Zoe. 9-540. Fan Fare. 10-368. The Inexhaustible Punch Bowl. 10-428. The Shower of Gold.

Tricks Involving Unusual Ability, Superior Information, etc.

Mathematical. 9-42. To Discover a Given Card. 9-47. The Four Packets of Cards Having been formed Face Downward on the Table to Discover the Total Value of the Undermost Cards. 9-52. To Make a Card Thought of Appear at Such Number in the Pack as Another Person Shall Name. 9-53. To Guess Four Cards Thought of by Different Persons. 9-54. The Pairs Repaired. 9-55. Another Method of Discovering a Card Thought of. 9-59. A Congress of Court Cards. 9-104. A Row of Cards Being Placed Face Downwards on the Table to Indicate by Turning Up One of Them How Many of Such Cards Have During Your Absence Been Transferred From One End of the Row to the other. 9-160. Odd or Even, or the Mysterious Addition. 9-265. To Turn Up a Domino Whose Points Shall Indicate How Many Have Been Moved in Your Absence. 9-267. The Dominoes Being Arranged in a Row to Name Blindfolded the End Numbers of the Row. 9-269. To Name Without Seeing Them the Points of a Pair of Dice. 9-213. To Indicate on the Dial of a Watch the Hour Secretly Thought of by

Any of the Company. 9-560. The Q Trick. 10-237. The Expunged Numeral. 10-241. To Predict the Sum of Five Rows of Figures.

Code or Confederate. 2-184. Mental Magic. 2-197. Silent Thought Transference, Number One. 2-199. Thought Transference, Number Two. 4-61. The Spirit Thinkaphone. 4-63. Tachy Psychography. 4-65. Hypnognotism. 4-79. Head of Ibykus or Talking Skull. 5-22. Thought Reading in Cards. 6-49. Euclid Outdone. 6-41. McLaughlin's Thought Reading Trick. 5-6. Giving Number of Banknote in Sealed Envelope. 5-57. Magnetic Handkerchief. 9-56. To Guess by the Aid of a Passage of Poetry or Prose Such One of Sixteen Cards, as, in Your Absence has Been Touched or Selected by the Company.

Mediumistic Feats. 2-50. Spiritualistic Knots and Ties of Many Kinds. 4-22. The Three-knotted Charmed Handkerchief. 4-23. The Eglinton Rope Test. 4-24. One of the Davenport Rope Ties. 4-25. Braid and Tape Test. 5-59. Eglinton's Famous Slate Trick. 7-18. Spirit Writing With Pencil Thimble. 7-44. Spirit Writing With the Toes. 7-52. The Thumb Pencil Writing. 7-86. The Cotton Bandage Test. 7-105. Slade's Accordion Trick. 8-144. The Picture Medium. 8-178. The Slate Medium and the Sealed Envelopes. 8-184. Dark Circle Trick. 9-238. TheVanishing Knots. 10-250. Reading Blindfold. 10-251. Dr. Lynn's Second Sight Trick.

Superior Information or Ability. 9-47. To Place the Four Kings in Different Parts of the Pack and to Bring them Together by a Simple Cut. 9-48. The Four Kings being Placed under the head of One Person, and the Four Sevens under the Head of Another, to Make Them Change Places at Command. 9-50. To Name All the Cards of the Pack in Succession. 9-51. The Cards Being Cut to Tell Whether the Number Cut is Odd or Even. 9-51. The Whist Trick, to Deal Yourself All the Trumps. 9-57. To Detect Without Confederacy Which of Four Cards Has Been Turned Around In Your Absence.

Tricks Depending on a Large Use of Fixed Mental Habits in the Audience.

Sleight-of-Hand With and Without Apparatus. 1-119. Hermann's Best Handkerchief Trick. 1-126. Another Handkerchief Vanish. 1-129. The Color-Changing Handkerchief. 1-133. Changing a Handkerchief into a Billiard Ball. 1-138. The Multiplying Billiard Ball. 1-139. The Chameleon Billiard Ball. 1-141. Samuel's Improved Chameleon Billiard Ball. 1-161. The Multiplying Coins. 1-184. The Fish Bowl Production. 1-188. The Flying Cage. 1-194. Chronological Catastrophe. 1-200. Hermann's Klingklang Trick. 1-202. The Spirit Calculator. 1-204. Heavy Weights from a Hat. 1-291. A Comedy of Errors. 2-106. The Cone of Flowers. 2-112. The Birth of Flowers. 2-114. To Pass a Finger Through a Hat. 2-119. The Egg and Hat Trick. 2-122. The Dissolving Coin. 2-132. The Invisible Journey of a Glass of Wine. 4-5 Handkerchief Multiplication. 4-8. The Flight Through Crystals. 4-11. Postal Card Trick. 4-15. Programme, Ring, and Envelope Trick. 4-16. Bertram's Programme and Coin Trick. 4-78. Catching Bullets on a Plate. 5-19. The Winged Numbers. 5-23. Yank Hoe's Paper Trick. 5-24. Cigarette and Card Trick. 5-26. Ornithological Labyrinth of Perplexity. 5-28. Tambourine and Paper Trick. 5-29. Valensin's Multiplying Coins. 5-44. A Coin Sleight. 6-29. The Flying Thimble. 7-128. The Miraculous Wine Glasses. 9-214. To Bend a Borrowed Watch Backwards and Forwards. 9-240. To Exchange a Borrowed Handkerchief for a Substitute. 9-254. Plumes from an Empty Handkerchief. 9-268. To Change Invisibly the Numbers Shown on Either Face of a Pair of Dice. 9-308. The Hundred Goblets from a Hat. 9-325. The Vanishing Gloves. 9-329. Egg Production. 9-163. To Make a Marked Quar-

ter and a Penny Wrapped in Separate Handkerchiefs Change Places at Command. 9-164. To Make Two Marked Coins Wrapped in Separate Handkerchiefs Come Together in One of Them. 9-168. To Pull Four Quarters Through a Handkerchief. 9-170. To Pass a Marked Quarter Into the Center of Two Oranges in Succession. 9-172. To Make a Coin Pass Invisibly from the One Hand to the Other, and Finally Through the Table. 9-175. To Rub one Penny Into Three. 9-180. The Travelling Counters. 9-181. The Wandering Coins. 9-227. To Pass a Ring From One Hand to Either Finger of the Other Hand. 9-228. To Pass a Ring Through a Pocket Handkerchief. 9-228. To Pass a Ring Through the Table. 9-230. To Pass a Ring Invisibly upon the Middle of a Wand, the Ends being Held by two of the Spectators. 9-231. The Magic Ball and Rings. 9-233. To Pass a Borrowed Ring Into an Egg. 9-272. Cup and Ball Conjuring. Four Movements Necessary: First, to Palm the Ball; Second, to Reproduce the Palmed Ball at the End of the Fingers; Third, to Secretly Introduce the Palmed Ball Under the Cup; Fourth, to Simulate the Action of Placing the Ball Under the Cup. 9-276. To Produce a Ball from the Wand, and to Return a Ball Into the Wand. 9-277. To Pass One Cup Through Another. 9-279. Having Placed a Ball Under Each Cup, to Draw it Out Again Without Lifting the Cup. 9-281. To Make a Ball Travel Invisibly from Cup to Cup. 9-283. Having Placed Two Balls Under the Middle to Make them Pass Under the Two Outer Ones. 9-282. Having Placed a Ball Under Each of the End Cups, to Make Them Pass Successively Under the Middle Cup. 9-283. To Pass Three Balls in Succession Under One Cup. 9-284. To Place Three Balls, One After the Other, Upon the Top of One of the Cups, and to Make Them Fall Through the Cup on to the Table. 9-285. To Pass Three Balls in Succession Upwards Through the Table into One of the Cups. 9-286. To Pass Two Balls in Succession from One Cup to Another Without Touching Them. 9-287. The Multiplication Pass. 9-288. To Transform the Small Balls to Larger Ones. 9-289. To Again Transform the Balls to Still Larger Ones. 2-125. Second Sight. 4-19. Slade's Spirit Knots. 5-10. Reading Sealed Messages. 7-32. Spirit Writing on Double Sealed or Locked Slates. 7-41. Spirit Writing While You Look. 7-49. The Slate Exchanged. 7-54. Another Method of Answering Sealed Questions. 7-58. Foster's Mind-Reading Trick. 7-72. The Table Lifter. 8-147. Slate Writing with Materialized Pencil. 1-221. The Spiritualistic Sack. 2-123. The Spirit Slates. 4-21. Bellechini's Cabinet Mystery. 4-27. New Spirit Post. 4-28. Spirit Hand. 5-15. The Original Slate Mystery. 7-4. Single Slate With Flap. 7-7. Endless Band Silicate Trick Slate. 7-9. With Two Slates and a Flap, to Produce a Message on a Blank Piece of Paper. 7-47. Another False Flap Method. 7-96. The Handcuff Trick. 8-140. The Carpet Slate Trick. 8-153. Slate Writing by Aid of the Trap. 6-21. The Magic Tambourine. 5-28. Candle and Rings. 5-47. Electric Coin Shuffle. 5-53. Ball and Changing Tube. 4-6. Soup Plate and Handkerchief. 4-12. Demon Cards. 4-13. Magic Die, Flowers, and Glass Box. 4-13. The Vanishing Billiard Ball. 1-135. Vanishing a Solid Billiard Ball from a Glass of Water. 1-154. Ring and Bottle Trick. 1-157. The Rabbit Trick. 2-48. The Decapitation Trick. 2-105. Egg and Handkerchief Trick. 2-117. A Cake Baked in a Hat. 2-120. Multiplication of Coins. 2-121. Magic Coins. 2-129. The Travelling Bottle and Glass. 2-130. Disappearance of an Apple and Ninepin. 9-121. The Magic Sword. 9-182. The Heads and Tail Trick. 9-183. The Magic Cone and Vanishing Coin. 9-185. The Animated Coin. 9-198. To Pass a Coin Into a Ball of Wool. 9-225. The Flying Ring. 9-241. The Locked and Corded Box and the Washerwoman's Bottle. 9-251. The Shower of Sweets. 9-313. The Welch Rabbit. 9-321. The Bonus Genius. 9-337. The Rice and Orange Trick.

9-401. The Chinese Rings. 9-419. To Vanish a Die Through the Crown of a Hat. 9-426. The Decanter and a Crystal Ball. 9-427. The Die and Orange. 1-143. The Rising Cards. 1-187. Cazeneuve's Card in an Orange.

Card-Tricks. 9-64. To Make a Card Vanish from Pack and be Found in Person's Pocket. 9-66. To Teach the Company a Trick which They Learn Without Difficulty, Then to Allow Them to Suceeed, or Cause Them to Fail at Your Pleasure. 9-69. To Distinguish the Court Cards by Touch. 9-70. To Name Any Number of Cards in Succession Without Seeing Them. 9-71. To Make Four Cards Change from Eights to twos, from Black to Red, etc. 9-73. A Card Having been Drawn and Returned and the Pack Shuffled to Make It Appear at Such Number as the Company Choose. 9-76. The Three Card Monte Trick. 9-77. To Nail a Chosen Card to the Wall. 9-77. The Inseparable Sevens. 9-79. The Inseparable Aces. 9-84. To Cause a Number of Cards to Multiply Invisibly in a Person's Keeping. 9-86. The Pack Having Been Divided into two Portions Placed in the Keeping of Two Different Persons, to Make Three Cards Pass Invisibly From the One to the Other. 9-90. To Make Four Aces Change to Four Kings, and Four Kings to Four Aces. 9-93. To Change Four Aces Held Tightly by a Person into Four Indifferent Cards. 9-97. The Shower of Aces. 9-103. Two heaps of Cards Unequal in Number Being Placed Upon the Table to Predict Before Hand which of the Two the Company Will Choose. 9-108. The Cards Having Been Freely Shuffled and Cut into Three or Four Heaps, to Name the Top Card of Each Heap. 9-110. To Allow a Person Secretly to Think of a Card, and even Before Such Card is Named to Select it from the Pack and Place it Singly Upon the Table. 9-115. To Change a Drawn Card into the Portraits of Several of the Company in Succession. 9-119. To Deal Yourself All the Trumps, the Three Other Players Holding the Usual Mixed Hands.

Typical Conjuring Deceptions.

For the illustration of the principles involved in conjuring, by showing something of the means employed in the performance of the feats, and as furnishing a basis for subsequent remarks, there follow below, in skeletal form, a number of tricks of the different groups. While the psychical element, the real flesh and blood of the trick is wanting, the omission is in part atoned for by a fuller statement of the principles involved in several special tricks given in the discussion. It has been asserted that in the nations of antiquity, the facts of science so far as then known were exhibited by the priests as evidence of divine power. In this age of discovery magic still makes use of them for the pleasure of a wonder loving world. Scientific features at present completely dominate the programme of the high class conjurer. In truth, however, these contain less of interest for the psychologist. The effects they permit of do not depend so much on an ideational contribution, hence, they do not vary so much with the individual. Being almost purely sensory, the illusion is the same in the case of the scientist to whom it is merely a puzzle or who may even know the principle, and the ignorant man to whom the feat is still colored with magical qualities.

Optical Illusions.

In optics the most astonishing effects are produced as the result of skillfully placed mirrors, plate glass, and magic lanterns.

2-69. The Living Half Woman.

Effect. On a small table rests a three-legged stool, supporting a cushion and the half lady. Lady moves and speaks, brilliant light. Visitor can see the four legs of the table, and the space under the stool. Method. Two mirrors set at angle of forty-five degrees under stool, side legs of table also connected with middle one by two mirrors.

2-77. The Decapitated Princess.

Effect. Head resting upon two swords lying across the arms of a chair. Method. An opening in chair back, below swords through which lady's head protrudes. It is concealed by a mirror placed at forty-five degrees reflecting the red plush of seat of chair. Variants are the Talking Head, Stella, The Spider and the Fly, The Mystery of Dr. Lynn.

2-72. She.

Effect. Lady standing on a small round stand beneath which the four legs and four lighted candles are seen. Cylindrical cloth screen lowered over lady to level of table. At pistol shot screen and lady are ignited; when burned out, a pile of bones and skull remain on table. Method. Mirrors meeting at right angles under table reflect two legs and two candles to make them seem four. Lady descends through trap in table top when screen is lowered.

7-136. The Mermaid's Head.

Effect. Upon a light tripod stands an aquarium with goldfish swimming in it, and in the center a head which moves and smiles. Method. Three triangular mirrors above the crossing place of the legs form a place serving to conceal body, and permit of placing head in the central cavity of transparent glass in aquarium.

1-250. Metempsychosis, or The Walker Illusion.

Effect. Living forms walk bodily out of blank space, change into other shapes and finally vanish. A ghost becomes visible and develops into a living person. Process reversed. Method. Large plate glass mirror—on rollers, transparent at one end and silvering gradually increasing in density—set at proper angle. Keller's blue room on this principle.

2-79. Keller's Queen of Flowers.

Effect. A screen eight by ten feet in three divisions. The bottom is a floor raised about one foot from the stage, an electric light under each division, a semi-circular stand placed in front of middle panel at same height as floor. At roof is a brass rod from which hangs a curtain inclosing the little stand. Audience can see if any one seeks to get behind curtain, yet when curtain is drawn, a lady surrounded by flowers is seen on the platform. Method. Invisible mirrors running from floor to roof of summer house form a passage way through which one can walk from behind scenes to stand while the audience still keep guard.

2-81. Houdin's Magic Cabinet.

Effect. An empty cabinet shown and examined by spectators. A lady enters and the doors are closed, when opened the lady has disappeared. They are closed and she reappears. Method. The sides of cabinet are the backs of two mirrors, when the doors are closed upon the lady, she pulls the mirrors towards her till they meet at the pole in the front of cabinet rendering her invisible.

2-86. The Platinized Glass Illusion.

Effect. The image of a person looking in mirror may be changed to portrait of a horned devil. Method. Mirror gives image by reflec-

ted light but is transparent by transmitted light, which may be admitted by shutter to show image placed behind glass.

2-60. The Three-headed Woman.

Effect. Curtain drawn back a woman's body is seen, it has three heads, two springing from the neck of the third; they sing, etc. Method. A mirror, facing audience. On an inclined board which rests against the screen in front of the stage, lie three young girls, the middle one in light colored silk. The bodies of the two at the sides are covered with fabric of dead black color. In front of them are placed powerful lights.

1-234. Black Art.

Effect. Stage setting and everything in black except the articles which are to appear, these are white. The performer in white silk commands the spirits. His wand comes out of space to his hand. Two small tables suddenly appear when desired. Refreshments are served from empty vases, doves and rabbits are then produced from them, and thrown in the air when they disappear. Performer produces a lady from a shawl, severs her head with a knife and places it on a pedestal. The body is still seen to move. Many other startling effects are produced. Method. Stage in dead black. Reflectors on sides and in front face audience. Articles to appear are placed behind black screens. Assistants in dead black move freely about the stage and are invisible, when head is deposited on pedestal, lady walks behind screen head only showing.

2-61. Amphitrite.

Effect. Through a circular aperture in a screen appears a scene representing the sky, below in foreground is the sea; at command a nymph rises from sea into space in which she turns round and round, gracefully moving arms and legs. She finally assumes position of a diver and plunges into ocean. Method. Mirror inclined forty-five degrees to stage, nymph strongly illuminated lies on a revolving table below the stage, table pushed forward to make her appear, and pulled back at the end of performance.

2-520. Gone.

Effect. Lady tied in a chair, raised by windlass a few feet above stage. Performer fires a pistol, at same instant lady vanishes and chair drops to floor. Method. A row of lights on frame of windlass are turned off at instant that pistol is fired. Another row up over the proscenium are at the same instant turned on, and they brilliantly light up a background corresponding to background of stage. The front of frame unknown to audience is covered by a sheet of glass which receives image of background above, and hides rear background and lady from sight. Another method sometimes used is to drop a black screen at pistol shot.

2-55. Cabaret du Neant.

Effect. Subject placed in a standing coffin changed to a grinning skeleton and back at command. He is next placed at a table, when audience see a spirit approach and gesture to him. Method. A skeleton is in a coffin unseen by spectators, when the light is turned on it has its refracted image from large plate glass thrown so as to coincide with the person in the second coffin. In the same way the spirit is made to walk.

7-46. Spirit Message by Aid of Mirrors.

Effect. A person writes a question on a slate, places it written side down on the table. The medium places one hand on slate, and with the other writes a commnnication which is the answer to the unseen question. Method. The slate is placed over a trap; trap is opened and three mirrors at forty-five degrees reflect writing to the place medium is sitting.

Acoustic Illusions.

An example of the illusions of this class may be taken from the ventriloquists who exhibit in public large articulated puppets in connection with their art. The aim of the ventriloquist is to produce an illusion of a voice proceeding from a point other than its real source. In order to deceive his listeners more completely, an unusual tone of voice is used. Contrary to the popular opinion, these sounds are not thrown but their locality is suggested by all the means of the actor's art, and by the employment of talking figures. The moving mouths of these puppets and the still lips of the performer produce an effect which especially on the stage is absolutely perfect. The puppets are so constructed that under the manipulation of the performer, they move their limbs, shrug the shoulders, shake the head, wink, make faces, and move their jaws in such a way as to seem to utter the words that the spectator hears. In order that the lips of the magician may be kept motionless during the performance, a selected vocabulary of words, free from labials is necessitated. This fact will not be perceived by the audience if the artist does his work well. A good setting enhances the effect very much, and real acting is as important here in creating the illusion as in any other branch of conjuring. The difficulty of localizing the origin of sounds is shown in many familiar cases. It is well understood by those who study stage effects; should an actress who is no vocalist have a part requiring her to sing, she has only to simulate singing while the vocalist in the wings supplies the notes with little fear that the audience will detect the imposture. So the beautiful chorus girls stand on the front row, but the volume of sound is contributed by their plainer comrades behind. In spiritualistic seances where stringed instruments float across the stage giving forth melodious sounds the while, the man with the bow plays an instrument in contact with the wire, but unseen by the audience. Where a cannon is fired on the stage only a fulminating cap is flashed before the spectators, the real explosion taking place outside. The resounding smack heard when one clown slaps another is produced by the victim clapping his hands at the instant he is struck. The audience following the larger movement do not see this. A common laboratory experiment where the subject sits blind-folded and is required to judge of the direction and distance of sounds made by a snapping instrument shows the difficulty the ear experiences in localizing sounds. The results obtained indicate that, in general, judgment is based upon the relative intensity of the sounds reaching the two ears; while the general direction of right and left are sensed, no approach to accuracy oc-

curs. Our spatial ideas are for the most part a complex effect of tactual and visual sensations past and present, and audition contributes but little. The ability of the ear to discriminate the source of sounds therefore, is in no way comparable to the eyes' power to focus on the object of vision. Indeed the ear does not trust to its own accuracy but relies so far as possible on aid from the eye, which, biologically considered, is by far the more important sense. It is plain, therefore, for the reasons given that the use of the puppet is an advantage in the production of the illusions referred to, for the eyes of the spectator are irresistibly drawn to its moving lips, and his mind acting under the usual association, as explained elsewhere, is impelled to attribute the voice to it also.

2-103. Houdin's Magic Harps.

Effect. Two harps, placed upon the stage play in concert. Intervention of spirits. Method. The harps are in contact with two fir rods which pass through floor, and rest upon harps played by skillful musicians below. Several variants.

9-222. The Mesmerized Watch.

Effect. Performer makes passes over a borrowed watch to change it as he says into a repeater. He then asks it to tell the hour that last struck, when the watch chimes the number with a clear bell-like tone, and answers other questions, three strokes for yes and one for no. Method. The strokes are made by a clock bell with a striking mechanism placed in the pocket. It is set in motion by pressure on a button.

A variant is the spirit bell. Effect. An ordinary bell placed on a plate of glass tells fortunes, ages, etc. Method. A second bell in table connected with an electric battery.

4-91. Poe's Raven in the Garland of Thebes.

Effect. A raven sitting in a garland of roses suspended in mid air by ribbons talks, sings, whistles, and tells fortunes. Method. The raven is stuffed, ribbons double and contain a rubber tube running behind scenes. The voice of a confederate passes out of tube in a direct line with bird's mouth.

9-159. A Borrowed Coin being Spun on a Table to Tell Blindfold whether it falls head or tail upwards.

Method. Substitute a coin prepared by cutting the edge so that a minute point will project from one side. When spun on this side it will run down more rapidly, and the difference in sound is distinguishable to an attentive ear.

4-36. Keller's New Karmos.

Effect. Lady sits on a chair facing audience. Performer blindfolds her and makes magnetic passes over her. The lady names cards, the numbers of banknotes, and other second sight feats. Method. Assistant behind scenes with a strong glass sees everything, and tells the lady what to say by means of an invisible speaking tube passing from behind the wings under the floor and up the rear leg of chair. Performer under pretense of hypnotizing the lady connects the tube in her hair to the one in chair.

Electrical Deceptions.

9-483. Houdin's Light and Heavy Chest.

Effect. The weight of a chest changed at the command of the magician. Method. Electro-magnetism. Box with iron plate on bottom

placed in contact with studs, connected with electro-magnet and this with battery below stage.

9-485. Spirit Rapping and Telegraphy is frequently produced in many forms by the aid of elctro-magnetism. A keeper, to which is attached the knocker, is drawn down by making circuit, and drawn back by a spring on breaking it. The apparatus is concealed in table and wires leading down hollow leg to battery. Magic bells and drums on the same principle.

3-122. Houdin's Crystal Cash Box.

Effect. A transparent box suspended above stage,—performer takes a number of coins in his hand and saying pass, they vanish from his hand, and are heard to fall in the crystal box where they become visible. Method. Coins are pushed through trap in table and placed by assistant in a glass flap against lid of box before bringing it in, in which position they are invisible. At a signal the circuit is completed through a wire holding glass flap; a fuse is melted and coins released.

7-62. The Educated Fly.

Effect. A large mirror resting against an easel is marked by the performer in twenty-eight squares, and lettered a to z. One of the remaining squares is zero, and the other is left, as the conjurer says, for a starting point. A large fly is placed on the empty square; whenever a number is called for, the fly travels across and stops at the desired square. Method. Boy behind mirror with strong electro-magnet causes fly to move over desired course to corresponding square.

2-96. The Neo-occultism.

Effect. A diner with eye-glasses and armed with knife and fork attacks a beefsteak. At a signal lights go out, a skeleton appears sitting opposite gentleman who has disappeared, his glasses alone remaining visible. Method. A black curtain on the other side of the table conceals from spectators a skeleton covered with zinc sulphide, when the lights are extinguished, a concealed Ruhmkorff coil is put in action. The skeleton, the tableware, and the eye-glasses are alone visible.

3-114. The Demon Candlestick.

Effect. Candles lighted at command. Method. Candles hollow, secretly connected with the gas pipe. Wires are led up to wick of candle, ignited by an induction coil giving a two-inch spark or by a plate machine.

Chemical Effects.

7-11. Spirit Writing.[1]

Effect. A blank piece of paper placed between two slates and laid on table in sight, is later found to have a message on it. Method. Invisible message written previously with dilute sulphuric acid. In the body of table is placed a lamp. The top of table is iron,—heat blackens the acid. A variant is to place the message previously written with a weak solution of copper sulphate in a vessel containing some ammonia. A similar method is to place the writing done with iron sulphate in contact with a surface moistened with a solution of nutgalls.

7-43. The Caustic Pencil Trick.

Effect. Medium takes victim's slate and with a pencil covers both sides with writing to see, so he says, if it is good enough for the test. He cleans both sides, and requests him to hold it close to his breast. On removing it writing is found on the side nearest him. Method. Pencil pointed at both ends, after writing several lines, the medium writes between them with a silver nitrate end, wets slate with salt water, writing white when dry.

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[1] Robinson in "Spirit Slate Writing" gives thirty-seven formulas for sympathetic inks.

Another method is to write on slate with a solution of hydrochloric acid and zinc, it is invisible while wet.

7-51. Reading Questions in Sealed Envelopes.

This is hardly to be classed as chemical, but is a favorite with mediums. Prepare a sponge with alcohol, brush envelope and writing within becomes plainly visible.

4-30. Spirit Pictures.

Effect. Medium shows a wooden frame on which is a piece of cloth, a picture gradually appears on cloth. Method. Picture prepared beforehand on unbleached muslin, using sulphate of iron for blue, nitrate bismuth for yellow, sulphate copper for brown. Medium in cabinet behind with an atomizer sprays solution of prussiate potash, which brings out colors. Spirit music to hide noise of atomizer.

2-134. The Wine Changed to Water.

Effect. Conjurer asks a spectator to take refreshment. Waiter brings in two glasses and two transparent decanters. One contains red wine, the other water. The guest is asked to make a choice, and pours red wine into his glass which changes to water. The conjuror pours out water which becomes wine. Method. The wine was potassium permanganate and sulphuric acid, and was clarified by sodium hyposulphite in bottom of glass. The water was partly alcohol, and readily dissolved analine red in other glass. Many other chemical combinations are used.

3-71. The Enchanted Sun Glass.

Effect. Fire set to paper by focusing rays from a candle. Method. In the handle of the sun glass is contained a solution of phosphorus in carbon disulphide. Liquid discharged on paper by a push-button.

5-58. Balloon Production.

Effect. Six inflated gas balloons produced from a hat which is first shown empty. Method. A half ounce of water in each of the empty balloons. In the neck of each has been place a small bag containing calcium carbide. One at a time the water is permitted to reach the carbide and generate gas.

3-98. The Strange Disappearance.

Effect. A solid silver elephant placed on a column and covered by a glass and scarf disappears. Method. Elephant is of mercury frozen by evaporation of solid carbonic acid dissolved in ether or by frozen air; when exposed it soon melts and flows into an opening in the stand.

Mechanical Tricks.

7-74. Houdin's Floating Piano and Performer.

Effect. Lady seats herself and plays piano placed against side scenes, closing cover she reaches toward bouquet on table which comes to her hand. She is seen to rise half way to top of stage, then glide to opposite side of room and out. Piano rises and follows her. Method. Invisible wires running over pulleys. Piano is drawn out behind from a papier machè shell, shell alone is floated out.

7-110. The Wire Cage Test.

Effect. The iron cage is subjected to rigid examination. Medium enters and is locked in. Usual manifestations take place. Method. One rod unscrews, releasing others. Many trick cabinets, handcuffs, etc., on same principle.

9-203. The Magic Coin Wand.

Effect. Touching any spot with wand a coin appears on end. Method. Wand is a hollow brass rod slotted along the side. In this a stud works to push a split coin out or to withdraw it. Use in connection with palmed coins or money slide.

9-215. The Watch Mortar.

Effect. Borrowed watch dropped in mortar, pounded with a pestle, pieces loaded in a pistol and fired at a loaf of bread. Watch found uninjured in loaf. Method. Mortar with movable bottom, watch drops through into other hand and is palmed. A dummy watch is pounded up and placed in pistol, when conjuror fetches the loaf he inserts watch. A variation is to shoot at a target, when the borrowed watch is seen to alight on a little hook in the middle. Target is reversible and held by a spring which is released at shot. It reverses too quickly for the eye to follow. A trick on the same principle is the Fairy Star. Six cards chosen by spectator are loaded into a pistol and fired at a gilt star brought out by an assistant. At shot the six cards are seen to appear attached to the points of the star. Method. The cards chosen are substituted, while performer loads six others into pistol, the assistant places the cards on springs behind the rays of the star and brings it in for target. The springs are released at shot, and cards appear. The card bouquet is a variant.

2-27. Vanity Fair.

Effect. A large looking glass with a shelf at bottom. Using a ladder a lady steps upon the shelf, turns to glass and inspects her reflection. A screen so narrow that a considerable portion of the mirror shows on each side of it is now placed around her. After a moment, screen is removed and lady has disappeared. Method. A section, cut in mirror below, slips up, leaving an opening. A sliding platform is pushed forward from an opening in the rear scene, and lady is drawn through by assistants.

9-34. The Magic Palanquin.

Effect. A lady in a palanquin carried by four slaves. At a given moment the curtains are drawn, and then immediately opened, the lady has disappeared. Method. The four posts are hollow containing a cord working over pulleys at the top. At the moment curtains are drawn counterpoises are disengaged and rapidly raise double bottom with lady up to interior of canopy.

2-35. Kellar's Cassadaga Propaganda.

Effect. A small cabinet forty-two inches high, thirty-six inches wide, and fourteen inches deep is placed on two chairs. Tambourines and bells are placed inside, and doors closed. The instruments begin playing and are then thrown out at the top. Cabinet opened and found empty. A slate placed therein has a message written on it. Other effects. Method. Cabinet is suspended in part by fine wires; a small boy perched on a shelf at back of cabinet is the moving spirit.

2-42. The Disappearing Lady.

Effect. A lady seated on a chair is covered by a silk veil. After counting three, veil is lifted and lady has gone. Method. Trap. May be used in reverse order.

2-89. Hermann's Trilby.

Effect. A plank is placed upon the back of two chairs. Trilby enters, lies down upon the plank. Hermann makes passes over her, then removes the chairs, leaving her floating in the air. Method. A bar protruded from a strong frame with moveable slide, works behind scenes. It is guided by performer under cover of his passes into its socket. A variation of this is to suspend plank by invisible wires before removing chairs.

8-153. Slate Writing via the Trap.

Effect. The "sitter's" locked or clamped double slate is held beneath the table by both inquirer and medium. It is later found to have a message on it. Method. Medium has convulsive jerkings and pulls slate from visitor for an instant and in giving it back substitutes

another. The slate is now passed through trap to an assistant below who opens and writes, fastens and returns slate.

7-7. The Endless Band Silicate Slate.

Rollers in frame of slate. A little stud pushed up brings previously written message on back of slate to front.

2-46. The Indian Basket Trick.

Effect. The performer, sword in hand leads in a young lady declaring she must be punished. He blindfolds her. She finally escapes and runs off the stage; he follows and drags her in by the wrist blindfolded and compels her to enter an oblong basket, say five feet by two, and as deep as wide, which is placed on a low stand or bench so as to be raised clear of the stage. Closing the lid he thrusts the sword through the basket in various places. Piercing screams are heard from within and the sword when withdrawn is red with blood. When all is quiet the conjurer wipes his sword and tells the audience that he did it to punish her, but that she had left the basket before the sword was thrust in. He turns it over and shows it empty. At this interval the lady appears from some other part of the room, makes her bow and retires. Method. Two ladies dressed alike, after the audience have seen the first lady's features, she runs out and the second is dragged in blind-folded and placed in the basket. The basket has a false bottom or flap, when the basket is turned up for the spectators to see, the lady is left lying behind it while the flap simulates the bottom. A variant later produced makes use of the principle of the sphinx table having a mirror between bench and floor, behind which is a trap. When lady enters basket, she passes immediately below stage. The basket is shown empty, and the lady appears as before. Both forms given are improvements over the trick as performed by the Indian jugglers exposed by Prof. Bertram.[1] In one form the spectators are not allowed to look in the basket, but after the thrusting in of sword the boy's clothes are taken out and the performer jumps in the basket himself. Another mode of working the trick is employed where there is a wall as background; screens are used and at the critical period confederates raise a tremendous disturbance, in the midst of which the boy escapes.

Tricks Involving Unusual Ability, Superior Information, Assistance of Confederates, etc.

Under this heading might well be placed many card tricks not requiring sleight of hand, rope tying feats, and others requiring unusual skill, feats of memory as in the mind reading and second sight tricks, code tricks, and many requiring a confederate; also those involving superior information or knowledge of a mathematical nature, and puzzles.

Heller's Second Sight.

Effect. Lady blindfolded and seated before audience. Magician goes among spectators, receives from them various articles which the seeress accurately describes; of a strange coin, where coined, its denomination and date; of a watch, the metal, maker's name, the time, date, etc.; so of other objects however strange. Method. The questions put are words, syllables, or vowels from an ingenious code. By means of combinations of these, Heller could give the clairvoyant the names and other data of every variety of article. He could also give information without speaking a word, electricity being used.

[1] Bertram: "Are Indian Jugglers Humbugs?" Strand Magazine, January, 1900.

He gave the cue by some natural movement of arms or body to a confederate who telegraphed them to lady, a little machine in seat of sofa tapping off the signals to her. Others have the bottom of shoes placed in contact with electric apparatus. Many other forms or variations are used.

5-22. Thought Reading in Cards.

Effect. A pack of cards previously arranged in the order of hearts, diamonds, clubs, and spades. Exchanged for one given to be shuffled. Divide into seven or eight lots on the front of stage, one lot selected, the others removed. Secretly looking at bottom card in the lot taken off the top of selected lot, performer will know the order in which cards run. The blindfolded assistant is given this cue when she will be able to name the cards in order.

2-198. Silent Thought Transference, Number One.

Effect. Reading of bank-notes, numbers of watches, dates of coins, by medium. Method. Performer and medium count mentally and together. Practice enables them to do this with certainty. The numbers counted correspond to articles or ideas in the memorized code. signals for starting and stopping are used.

2-199. Silent Thought Transference, Number Two.

Effect. Pretence of hypnotizing medium, performer goes among audience who whisper what they wish subject to do. Having spoken to from twelve to twenty persons, the performer advances toward medium and waves his right hand in downward movement. She slowly rises and goes through desired performsnce. Method. A code of signs and things to be done are learned. These things are forced on the audience, performer's movement gives the cue.

The Thought Reading Artist.

Effect. Artist draws on blackboard a picture of animal or object thought of. Method. Magician has battery and shocking coil under his clothing. By taking hold of wire leading therefrom artist receives by signals information of the object that he is to draw. Another simple method is to communicate the desired information to artist by pulling a thread attached to her head, using a code of signals similar to Morse's alphabet.

9-56. To Guess by Aid of a Passage of Poetry or Prose Such One of Sixteen Cards as, In Your Absence Has Been Touched.

Method. A confederate and a code: animal, vegetable, mineral, verb, signifying respectively, one, two, three, four. Confederate selects such passage that the first word coming within either of the four categories, names the row, and the second gives the number or card in that row.

7-18. Spirit Writing With Pencil Thimble.

Effect. The skeptic holds one end of clean slate in one hand and the medium the opposite end. Both clasp their disengaged hands, slate is turned over and message found. Method. A piece of slate pencil fastened to thimble worn on forefinger; an elastic to vanish it when it is done with, or a tiny piece of pencil fastened to finger by flesh colored court plaster. Only a few words can be written within radius of finger. Must be written backward. A variant. Medium holds a card to forehead, presently an answer found thereon. In this case pencil is used on thumb.

7-44. Spirit Writing With the Toes.

A clean slate put on floor under the table. Hands of sitter and medium are clasped. Message appears upon slate. Method. Shoe slipped off, stocking is cut away. A bit of pencil attached to great toe or a piece of chalk held between toes.

2-50. A Spiritualistic Tie.

Effect. A committee tie a rope securely around medium's left wrist; he then places his hands behind him, the right wrist resting over the knots on the left, and the ends of the rope are tied down tight on the right wrist. Cabinet closed and phenomena occur. Method. In placing his hands behind him he gives the knot on left wrist a twist and covers the knot and twist with the right; when ready to release himself he gives his right hand and wrist a half turn releasing the twist lying on the knot, when the hand can be easily withdrawn to play the usual tricks, then returned. Many variations.

7-105. Slade's Accordion Trick.

Effect. Accordion held under table by strap end with right hand, keys being at the other end. Left hand on table. Accordion gave forth melodious tunes. Method. He skillfully reversed instrument as it went under the table. Holding firmly between his legs he used bellows, and worked the keys with one hand.

9-57. To Detect Which of Four Cards Has Been Turned Around in Your Absence. A Parlor Trick.

Method. Arrange cards face upward so that the wider margins are all one way.

9-267. To Allow Any Person To Arrange the Dominoes in a Row Face Downward, Then to Name Blindfold the End Numbers of the Row.

Method. The dominoes are to be arranged to match as in the game of dominoes. The performer previously abstracts one which makes it certain that the ends of the row will agree with the numbers on domino taken.

9-213. To Indicate on the Dial of a Watch the Hour Secretly Thought of by Any of the Company.

Method. A spectator is requested to think of any hour he pleases. The performer begins to tap the watch with a pencil. He asks the spectator to mentally count the taps, counting the first tap as one more than the hour he thought of. When the performer reaches eight he must tap on twelve, and thenceforward must tap the numbers in a reverse order. When the spectator counts to twenty, the pencil will be on the hour thought of.

Tricks Depending on a Large Use of Fixed Mental Habits in the Audience.

Sleight-of-Hand with and Without Apparatus. 4-78. Catching Bullets on a Plate.

Effect. A file of soldiers; cartridges marked by audience, collected on a plate by performer who gives each soldier one. They are placed in guns which are fired at command. Performer catches the bullets on a plate. Method. As he returns to stage performer substitutes wax bullets coated with plumbago for the real ones, which he later produces.

1-119. Hermann's Best Handkerchief Trick.

Effect. Handkerchief borrowed, given to spectator to hold, and is found in pieces; takes pieces, rolls them together, and gives them to gentleman again and asks him to rub his hands together to sew the pieces. Taking them back again they are found changed to a long strip. He loads it into a pistol and shoots at a lemon; on cutting lemon the supposedly original handkerchief is found inside. He places it on a plate to scent it, when his assistant sets fire to it. Taking the ashes from the plate, the performer rolls them up in a piece of paper, which he then bursts open, and showing the original handkerchief returns it to owner. Method. Skillful palming and substitutions.

1-138. The Multiplying Billiard Balls.

The effects are produced by use of one solid ball and two half shells. Operator can show one, two, or three balls of as many colors, making vanishes and color changes at will.

6-29. The Flying Thimble.

Effect. Performer waves right hand with thimble on forefinger backwards and forwards before and behind the left; thimble seems to have changed suddenly to other hand. Method. Thimble palmed in left is shown on finger at instant thimble is withdrawn.

2-106. The Cone of Flowers.

Effect. A Piece of Paper formed into a cone when gently shaken becomes filled with a great quantity of flowers.

Method. A package of flowers each containing a spring is held compressed by a band. It is palmed by performer and released when placed in cone.

2-112. The Birth of Flowers.

Effect. I. At a wave of wand a rose appears in buttonhole. Method. A rubber cord attached to rose passes through buttonhole and fastens to waistband. When first entering rose is held under arm. II. Seeds placed in a glass and covered by a hat. Hat removed and flowers are discovered. Method. Flowers introduced into hat while audience's attention is directed to glass.

2-114. To Pass a Finger or Wand Through a Hat.

A false finger concealed in hand is held in place from inside of hat by a needle attached to finger.

2-119. The Egg and Hat Trick.

Effect. Eggs taken from an empty handkerchief and placed in hat. Supply unlimited. Method. Egg behind handkerchief suspended by a thread. Raising handkerchief withdraws egg from hat.

2-122. The Dissolving Coin.

Effect. Coin is held by a spectator within folds of a handkerchief over a glass of so-called acid. At signal coin is dropped and heard to strike glass. Cover removed and coin found dissolved. Method. A glass disk the size of coin substituted for coin before spectator takes hold. It just fits the bottom of glass and is invisible in the water.

1-202. The Spirit Calculator.

Effect. A blank paper given to spectator is folded and kept in pocket. On another paper several persons in the audience write numbers of three figures each, when added they amount to the number found on the blank paper in first gentleman's pocket. Method. Performer under pretense of helping to fold blank paper substitutes one with a number on it, and as he passes the second paper with the numbers to a spectator to be added, he substitutes one containing several numbers amounting to the number on the blank paper.

9-254. Plumes in an Empty Handkerchief.

Effect. Handkerchief shaken to show that it is empty, large plumes then taken from it. Several repetitions. Method. Plumes grasped in hand when coat is put on, the ends reaching to the wrist are seized under cover of handkerchief. A variant is Hermann's Flags of all Nations.

1-184. Hermann's Fish-bowl Production.

Effect. Performer in evening dress, produces from a handkerchief several bowls of water with goldfish swimming therein. Bowls about seven inches in diameter, and two deep. The last one produced has a tripod attachment a foot or two high. Method. The bowls with strong rubber covers are disposed in pockets about performer's person. The tripod attachment to the final bowl is formed by a telescoping contrivance. Magicians often produce numerous glasses of wine of different sorts on the same principle.

1-126. A Handkerchief Vanish.

Effect. A silk handkerchief rolled in hands disappears and is found elsewhere. Method. A flesh-colored barrel or sack hanging to a finger receives it and is then swung to back of hand, and later disposed of if desired. Another vanisher used to vanish gloves and other articles is a receptacle attached to a rubber cord which flies beneath coat when released.

9-175. To Rub One Coin into Three.

Method. Previously stick two coins with wax to under side of table near edge. While rubbing coin with thumb above, scrape off coin below and produce. Repeat.

9-178. To Make a Marked Coin Vanish from Handkerchief and be Found in Center of an Orange.

Method. Ask a spectator to hold a coin in a handkerchief. Palm coin while placing it beneath, and give him a similar one which is sewed into the handkerchief. Performer now brings the orange, pushing coin into a slit in orange while doing so, shake out handkerchief and cut orange.

9-268. To Change Invisibly the Numbers Shown on Either Face of a Pair of Dice.

Method. Arrange dice so that the numbers shown on the face are the same, except in reverse order, on the next quarter turn, as three and one and one and three. Now, if dice are given a quarter roll between fingers as they are brought forward the numbers are seen reversed.

9-62. A card having been chosen and returned, and the pack shuffled to produce the chosen card instantly in various ways.

Method. A taper pack used. When a card is chosen pack is reversed and it can then be withdrawn by touch. With an unprepared pack the chosen card is brought to the top by the pass and palmed, and later produced at will.

9-69. To distinguish the Court Cards by Touch Blindfolded.

Method. A knife drawn along edge of each court card leaves a minute ridge perceptible to the touch.

9-73. A Card Having Been Drawn and Returned and the Pack Shuffled to Make it Appear at Such Number as the Company Choose.

Method. When chosen card is returned make the pass and keep palmed, produce at the number chosen. Very many variations based upon the pass and palming.

9-76. "The Three Card Trick."

Dropping a court card and two plain cards to tell the court card. Method. The operator holds them, face downwards, one between the second finger and thumb of the left hand, and the other two, one of which is the court card, one between the first finger and thumb, the other between the second finger and thumb of the right hand, the latter being outermost. Bringing the hands quickly together and then quickly apart, the cards are dropped in succession. The trick is an illustration of the fact that the hand can move quicker than the eye can follow.

9-90. To Make Four Aces Change to Four Kings and Four Kings to Four Aces.

Method. Four cards are kings on one side, aces on the other. Produce and palm as desired in a variety of ways.

9-103. Of Two Heaps of Cards Unequal in Number, to Predict which the Company Will Choose.

Method. Both heaps contain even numbers. By a palmed card the heaps are made odd or even as desired. Many tricks with "prepared cards" require considerable sleight-of-hand in their performance. In

general they are used for a special part of the trick. The tapering pack, as its name indicates, is broader at one end. A long card or a broad card is often used for forcing. When not forced or otherwise used in the trick itself, it is useful to place over or beneath other chosen cards to find them easily. Cards pricked in the corner are often used. Card sharpers doctor the pack to suit their purposes. In preparing the "strippers" used by them, two hands are selected from the pack and the remainder are trimmed down. A "brief" is simply a card kept out of the pack and trimmed convexly at the sides so that it can be distinguished by the touch.

Several kinds of mechanical changing cards are used but all have as their object the apparent transformation of the cards to different ones. In one case four cards have the spots so arranged that they can be shown as fives, but by reversing them they become twos. There may be spots on back and front. Aces with changeable spots worked by a pin through a slit in the back. Packs arranged in various fashions for vanishing.

9-139. In the "Torn Card" trick a card is torn to pieces and burned, except one corner, the ashes fired at a box on the table in which is found the card restored save for the corner torn off. This piece is now taken from the spectator and thrown or fired at the card when it is seen to be whole. Method. The restored card is of tin made to resemble a card with a flap of the shape of the missing corner held back by a spring, which is released at the proper time.

2-48. "The Decapitation Trick."

Effect. Clown placed upon a coffin shaped box. Head covered with a cloth. Harlequin cuts across his neck with a large knife, and in a moment lifts in the air the severed head. He places it by the headless trunk, a lighted cigarette is placed in its mouth, smoke comes from the nose, the eyes roll, in horror he again covers it with the cloth, takes and kneads it on to the body; figure rises an orthodox clown. Method. An assistant in the box which contains trap doors, a dummy head which is an exact *fac simile* of the clown's painted head and face. Variants are Vanek's Decapitation, and Herman's Decapitation.

1-157. "Hermann's Rabbit Trick."

Effect. Two rabbits are produced from a hat, placed on the table, one is rubbed into the other: a third is then pulled from the inside of a gentleman's coat. Method. The two are first produced from pockets. In rubbing them on the table one is pushed through trap. The gentleman, who is a confederate, has the third in his inside pocket.

9-401. The Chinese Rings.

Effect. Eight nine-inch steel rings given for examination, are found to be separate and solid, at the will of the operator they become linked together in an apparently inextricable mass. A shake causes them to fall apart upon the stage. Method. Rings really consist of one key ring, two single rings, a set of two and a set of three linked together. Many variations in combining them.

9-251. The Shower of Sweets.

Effect. A borrowed handkerchief is held over a plate when a shower of sweets pour forth and are caught by the plate. Method. A small bag with mouth closed by springs is introduced under handkerchief and opened.

9-373. The Inexhaustible Bottle.

Effect. Performer appears with bottle and glasses and serves any wine called for. Method. Bottle is of tin divided into a number of compartments, each tapering close to neck of bottle. A pin hole drilled into each compartment, fingers cover holes except the one to be drawn from.

9-388. The Coffee Trick.

Effect. Coffee berries change to hot coffee, white beans to sugar, and bran to hot milk. Method. By the use of apparatus of the double bottom order. Very many variations of the false bottom type.

9-398. The Wizard's Omelet.

Effect. Three rings borrowed, three eggs produced and broken into a pan, alcohol poured in and ignited; while still blazing the rings are dropped in, a cover placed over pan. When a pistol is fired cover is removed, and instead of omelet are found three live doves, each with ribbon around neck to which is attached a ring. Method. Rings were substituted. Assistant brings in the doves and rings in the double cover of the pan.

9-309. The Cannon Balls in the Hat.

Effect. A large cannon ball is found in a borrowed hat. Next a hundred goblets are taken from the hat, or a dozen large dolls or drums and bird cages, finally another cannon ball. Method. The first ball introduced into hat from table shelf is real, the second is hollow and contains a large number of spring dolls, collapsible bird cages, etc.

1-188. The Magic Bird Cage.

Effect. After exhibiting cage and bird, performer tosses cage up into the air and it disappears. Method. Cage is collapsible. It is attached to a strong rubber cord, running between legs to back waistband and disappears under coat-tail. To vanish cage stand with legs somewhat apart, make the tossing movement upward and follow with the eyes.

9-198. To Pass a Marked Coin into a Ball of Wool.

Method. Wind wool on a flat tin tube, three or four inches in length. To end a coin trick slip coin in tube, then pull out tube.

9-185. The Animated Coin which Answers Questions by Jumping up in a Tumbler.

1. Method. A long black thread attached to coin by wax. Assistant behind scenes pulls thread.

2. A piston working in hollow stem of tumbler is worked by assistant below stage.

III.

The Preparation of the Conjurer.

The psychological principles involved in the training of the conjurer for expertness merit brief attention. To become an artist the possession of certain natural qualities are essential. A pleasing personality, a strong eye and a hypnotizing smile are elements contributing to success, for the magician must, above all else, be able to inspire confidence. He is pre-eminently a suggester or an actor playing the role of a sorcerer; with his magic wand in hand he is no longer amenable to the natural laws of earth, but disports himself in a realm of miracles. By his dramatic ability he clothes his feats in the magic garb which distinguishes them from the jugglers performances.

In preparing for his art, two of the senses, sight and touch, must undergo special education. The famous Houdin, at the beginning of his career, was compelled to create the principles of his art and recognized the fundamental importance of these two senses. Taking a lesson from the skill acquired by pian-

ists, he saw that "by practice[1] it would be possible to create a certainty of perception and facility of touch, rendering it easy for the artist to attend to several things simultaneously, while his hands were busy employed with some complicated task." To acquire this faculty he had recourse to juggling, practicing until he was able to keep four balls in the air while, at the same time, reading a book without hesitation. This is a feat demanding the most perfect muscular co-ordination and nice adjustment of eye to muscle. It affords an example of the marvellous perfection to which an organ may attain by practice. "The juggler is obliged to give impetuses that vary infinitesimally. He must know the exact spot whither his ball will go, calculate the parabola that it will describe, and know the exact time it will take to describe it. His eye must take in the position of three, four or five balls that are sometimes several yards apart, and he must solve these different problems in optics, mechanics and mathematics instantaneously, ten, fifteen, twenty times per minute, and that, too, in the least convenient position."[2] By reason of such practice Houdin's fingers acquired such a remarkable degree of delicacy and certainty that he was able in his performances to lift from a pack of cards the exact number called for without looking at them, being guided alone by his exquisite tactual sense. His eye also gained a promptitude of perception quite beyond the normal. When he came later to train his son and himself for the second sight trick he found that a greater power of discrimination was possible. The method at first adopted was to name the number of spots on a group of dominoes at a glance. Beginning with nine spots they, at length, were able to give instantaneously the product of a dozen dominoes. The next exercise attempted was more difficult. Passing rapidly before a shop window they cast an attentive glance upon its contents. Halting beyond, lists were made of the objects seen. The boy could often note as many as forty articles, and Houdin thirty. He relates that this power enabled him to see everything that went on in the audience without appearing to do so; and to carry on two trains of thought simultaneously, to attend to what he was doing and to what he was saying. This dual performance is possible, as M. Paulhan[3] has shown, where the operations are easy and heterogeneous and have become very habitual. Where the processes must be sharply discriminated in consciousness, however, there is only rapid oscillation of attention. The acts and speech of the conjurer are practiced till they become to a great extent automatic and their simultaneous performance is

[1] Houdin's Memoirs, p. 48.
[2] Hopkins: Magic, etc., p. 139.
[3] Paulhan: Revue Scientifique, Vol. XXXIX, p. 684.

easily possible, leaving the mind free for other work, and Houdin tells us that he frequently invented new tricks or applications while going through his performances. Nevertheless, occasions do arise, as the experiences of the artist mentioned indicate when, because of unexpected developments, it is necessary that both processes become focal. He says that on one occasion a spectator who had tried to baffle his son's clairvoyance in the second sight trick, asked him to name the number of his stall, which was covered by his cloak. A sharp tilt of words resulted, when the question was put to the boy and correctly answered. He says "the way I succeeded in finding out the number of the stall was this: I knew beforehand that in all theatres where the stalls are divided down the center by a passage, the uneven numbers are on the right and the even on the left; as each row was composed of ten stalls it followed that on the right hand the several rows must begin by one, twenty-one, forty-one, and so on, increasing by twenty each. Guided by this I had no difficulty in discovering that my opponent was seated in number sixty-nine, representing the fifth stall on the fourth row." The results attained by this artist have been cited at some length as an indication of what every expert conjurer must acquire by analogous means.

Several questions may be raised as to what elements are involved in such an acquisition of skill. 1. Does this training to extraordinary skill in sense perception indicate a training in the organ involved, or in the brain centers? 2. How far, if at all, is this acquired ability of one sense or organ an education of others? As to the first question the answer may be made that both are true. The conjurer's hands "make the pass" and similar movements mechanically, for skill is largely by way of increase of automatic action. These feats work themselves while his mind is more or less actively leading off the attention of the audience to other matters. Beside greater perfection of movement, practice also brings increase of rapidity. Jastrow[1] has made experiments on Hermann and Kellar, the two most noted conjurers of the age, which demonstrate this. "For Mr. Hermann the maximum number of movements of the forefinger alone was 72 in 10 seconds, or 7.2 per second, and of the forearm 75 or 7.5 per second. For Mr. Kellar, forefinger 83 in 15 seconds or 5.5 per second and for the forearm 127 or 8.2 per second. The average of a large number of individuals for the forefinger movement was 5.4 per second, and of a group of ten persons, tested more nearly in the same way as were Messrs. Hermann and Kellar, 4.8 per second. The

[1] Jastrow, Joseph: Psychological notes on sleight of hand experts, Science, Vol. III, p. 685.

average forearm movement of the same ten persons was 7.5 per second. It thus appears that the movement for both Mr. Hermann and Mr. Kellar are rapid, Mr. Hermann's forefinger movement being exceptionally so, while Mr. Kellar's forearm movement is the better." In the ordinary form of reaction experiments for touch, sound and sight both of the special subjects reacted far more quickly than the ordinary individual. In the eye there is probably some gain in power of peripheral vision by such training as Houdin underwent; an idea of how far such increased efficiency is due to better habits of attention, however, may be gained from the studies of Dr. Ranke [1] on the South American Indians. He marvelled at the keenness of sight of his Indian guides. Nothing escaped them. They could shoot a fish in swift-flowing water, estimating correctly for refraction; could distinguish animals protectively colored from the background; could follow a trail on the ground where the whites saw nothing. He tested them with Snellen Types and found that in keenness of vision their eyes were no better than Europeans. He concluded that the differences lay in the fact that the Indians, through long practice, had a better apperception of what was to be seen. In time he learned to repeat their performances. Such studies suggest that the wonderful power of Houdin and his boy consisted largely in their ability to make focal in the mind those obscure stimuli which for the ordinary person hover faintly in the margin of consciousness.

The second question, as to how far training of one organ is capable of increasing the power of others, has not yet reached the point where a definite answer can be given. Experiments on both the physical and mental processes have been made, but the results are conflicting. Féré [2] found that motor-training increased the dermal sensibility. Leland,[3] from various visual exercises, claimed that increased power of relating and comparing was given and that in time the intellectual ability was increased. Miss Aiken [4] states that by a daily period of visual exercises with a rotating blackboard, a gain in power of concentration and discrimination was made which showed its effects also in other departments of the school work. On the other hand Jastrow [5] found that in estimation of movement of various kinds and in complicated mental reactions, the experts, Hermann and Kellar, both fell below the normal. In educational

[1] Dr. J. Ranke: Studies of the Senses of South American Indians, Gesellschaft Anthropologi, 1897.
[2] Féré, Ch.: L'influence de L'éducation de la Motilite volontaire sur La Sensibilité. Revue Phil., 1897, p. 596.
[3] Leland C.: Practical Education.
[4] Aiken, Miss C.: Methods of Mind-training.
[5] Jastrow, Joseph: *loc. cit.*

circles the mental gymnastic theory has lost ground, at least it is recognized that it must not be overworked. In the field of motor-training, however, with which we are chiefly concerned, it seems safe to say that training of one organ gives added power in others—certainly strengthening the symmetrical organ and probably giving finer co-ordination to the whole organism. Scripture[1] and his students have investigated these questions, and their results show clearly the gain in power made by the unpracticed member, an effect that undoubtedly comes about through the higher development of the nerve centers in the brain. Or put in other terms, the increased capacity is possible because of a better stock of images of movement.

Returning to the training of the conjurer we find among his accomplishments an unusual degree of skill with the hand. A special grasping power of the muscles of the inside of the hand must be cultivated, as it is the principle of palming, which is the chief means used to cause the disappearance of coins, balls, etc., the hand concealing the object while in appearance it is held open.

The special education of the conjurer calls attention to the harmony between the members of the body. In simple organisms all movements are movements of the entire body; contractions and expansions; with all the differentiation that has come about in the higher orders the tendency is still for the whole nervous organism to act as a unit. So closely associated are the sensory and motor processes, when in the bonds of attentive perception, that an object or movement of any sort engaging the attention of the individual is at once brought into the focus of vision. He is impelled to reach out and take hold of it or go towards it; at the same time his language will relate to the thing occupying him. All his powers are held in subjection to it, to the greater or less disregard of the rest of the world. With the conjurer it is otherwise. The "misdirection" upon which he depends for establishing his illusions is brought about by a subversion of the order above mentioned. He must learn dissociation. The hand most in evidence no longer acts in aid of the idea which the mind is attempting to have executed and which is indeed being quietly performed by the other hand. The eyes also cease to dwell on the act, and the words spoken to be in explanation of it, but rather serve to call attention to an unessential or a non-existent part. By gesture, glance and speech is the attention captured, and while thus psychically blinding his audience the artist calmly proceeds with the performance of his trick. In overcoming all

[1]Scripture E. W.: Studies from the Yale Psych. Lab., Vol. VI, also Cross-education, Pop. Sci. Mon., March, 1900.

these natural tendencies the performer must reverse the conventional theory and practice in education. He must oppose nature's law of economy and forge against the line of greatest resistance. The result of which is that he gains a region where the thought of ordinary men cannot follow. He now lives in the realm of miracles.

The road to excellence is a difficult one. In working up an illusion the artist must practice unceasingly till he has mastered the mechanical portion; he must then devote himself to the dramatic element, which as regards the effect upon the spectator, is by far the more important portion. He must not lose sight of the fact that he is playing the role of a magician, of a being possessing supernatural powers, and in every word and gesture should live up to the spirit of his part. Great deliberation in action is essential, as care must be taken not to make a parade of dexterity or to do anything to suggest the idea that the effects are produced as the result of dexterity. As before stated the secret of success lies in the appeal to certain mental habits and not in extreme rapidity of action. Chronophotographic pictures of the hands of a prestidigitateur were taken by Binet[1] at the rate of ten or twelve per second. Sleight of hand tricks performed with one or both hands were taken. "One is struck," he remarks, "on seeing the photos, with the fact of not finding therein the illusion which is so plain when the trick is executed before the eyes." The perfection of conjuring lies in the *ars artem celandi*—in so mystifying the spectators that they are unable to suggest any solution of the wonders they have seen.

It is essential that the second phase of a transformation be not exhibited until the audience have clearly perceived the first; the change of one card to another, of one coin to two, falls decidedly flat if the first stage was not clearly perceived. So in transforming an orange to an apple it is essential that the spectators notice that it was first an orange. Furthermore they cannot be trusted even then to make the idea focal in consciousness. They are in a more or less passive condition and the artist must strongly suggest the idea he would have entertained. It is difficult to fully comprehend the unique power his accomplishments and versatility afford the conjurer. To the amateur it is a revelation to find with what ease the audience can be deceived. The experience is pleasing. It fosters confidence in himself and gives him a sense of power. The audacity and coolness of the professional magician are a natural growth springing from the conditions with which his unique

[1] Binet: La Psychologie de la Prestidigitation. Revue Philosophique, 1894, pp. 346–348.

profession surrounds him. His success in his art depends in large measure on these qualities, but on the other hand they follow on an easy success. In time there develops the *sang froid* which does not admit of failure. Possessing several ways of performing a trick and being aware that the spectators will not know when he does fail, he carries off the affair to some conclusion possibly much different from his original intention.

IV.

Psychological Justification of the Rules and Practices of the Conjurer.

While the long list of conjuring tricks is of so varied a nature, both in method of performance and in effect, as to preclude all thought of classification according to psychological laws it is still true that some general rules have arisen which are observed by the artists in the profession, and many special practices applicable to individual tricks. It will be seen that these illustrate in a striking manner some of the ordinary laws of psychic action.

1. *Attention.* The mechanical portion of a feat of sleight of hand, it has been stated, possesses little power to illude the senses, that characteristic lies in the psychological features with which the performer clothes it. The technical outward appearance; the use of apparatus and dexterity count for little beside the ingenious use of certain mental processes. Of these attention deserves a prominent place. It is through the operation of attention, in large measure, that the effects are secured. Since it is so nearly conterminous with consciousness this is indeed to be expected. The division of attention adopted here is the common one of spontaneous or passive and active attention, but so far as the subject relates to the audience little notice need be taken of the latter. It is on the play of passive attention among the audience that the magician depends for establishing his illusions.

Manipulation of Attention Through Gesture and Speech.

Under this head may well be treated the part the attention plays in the production of conjuring illusions. (a) Gesture as here used includes every purposive movement of the hand, body and eye, and indeed all the play of features to express emotions or ideas. (b) The "patter" is the spoken discourse relating to the feats. The proper understanding and application of both classes of actions are of the greatest importance to the conjurer.

Gesture. Probably no better examples of the effect of community life upon the individuals of which it is composed, are

afforded than are found in the performances under discussion. A few illustrations will make this apparent. The conjurer plays upon certain fixed mental habits of the audience. He relies upon these to create a favorable opportunity to effect a given disappearance unknown to the spectators. The movements designed to divert attention are numerous. Each trick has its own appropriate gestures combined with the patter which supplies the pretext for them. In vanishing a dollar this is seen clearly. The description of this manœuver given by Dessoir[1] is excellent. The artist "takes the coin in his left hand, looks closely at the right hand, as if it were the most important and then takes hold of the dollar. This trick is so convincing that you would be willing to swear the right hand held the coin; the position of the fingers adapts them naturally to this supposition. As soon as he has taken hold he moves his right hand sideways away from the left hand, the whole body follows the movement, the head bent forward, the look in the eyes, everything forces the spectator to follow this hand. In the meantime the first two fingers of the left hand point to the right hand, while the two other fingers hold the coin which is covered by the thumb. By such shading, and particularly by the constant talking of the artist, the whole attention is concentrated on the right hand, and everybody makes up his mind to pay close attention to see how the dollar will disappear from this hand. He makes little backward movements with the fingers, by which they move gradually away from the palm of the hand, and apparently deeply interested in the phenomenon he says, "See how the dollar grows smaller and smaller, there it has disappeared entirely, melted away," He opens the fingers wide, straightens himself up, and the sparkling eyes seem to say, "How queerly that disappeared; it is strange." Again the performer ostentatiously places some article on one corner of the table at which he is performing, while the left hand, finding its way behind the table, gets possession of some hidden article to be later produced. In the trick of producing cannon balls from an empty hat, the first ball shown is real, the second is of hard wood painted black, and is placed beforehand on the servante. To introduce it into the hat which has just been shown to be empty, one takes the hat in the right hand, leaving the middle finger free to insert in a hole bored in the ball. The performer now advances his left hand to take the wand or some other article which is placed toward the front of the table, as a natural consequence of this movement the body is bent forward a little, the right hand sinks gently down to the level of

[1] Dessoir Max: The Psych. of Legerdemain. The Open Court, Vol. VII, p. 3609.

the table and the middle finger forthwith finds its way into the ball, lifts it up, and introduces it into the hat which covers the act completely. The spectators suspect nothing because they have been looking at the article picked up from the table and not at the hat. Sometimes by the ruffling of the cards the opportune moment is created; sometimes a ball is thrown into the air in order to gain an opportunity during the same instant, of taking unseen with the left hand another ball from the pocket or table shelf. Again a mere tap of the wand on any spot, at the same time looking at it attentively, will infallibly draw the eyes of the company in the same direction. Hermann's biographer says of him that "his 'misdirection' was beyond expression. If his luminous eyes turned in a certain direction, all eyes were compelled (as by some mysterious power) to follow, giving his marvellously dextrous hands the better chance to perform those tricks that were the admiration and wonder of the world."

Gesture, as to its power to attract attention, is to be referred back to a study of action in relation to the struggle for existence. Through far-reaching ages of primitive life in the war of all against all, it was essential to every creature to have an eye out for the moving object. In it lay the source of danger or dinner, as the case might be. Existence itself depended upon giving the moving object a correct interpretation. It was hence essential that it be brought into the field of clearest vision. The reflex reaction to movement in the eye was thus established through stern necessity, and still persists.

The biological significance of attention to movement as a means of self-preservation is attested in the fact that "both[1] the magnitude and rapidity of objective movement are far more adequately cognized in indirect than in direct vision." Experiment shows this to be true of the human eye, and the observations of hunters indicate that the fact applies in even greater degree to those wild animals to whom attention is still a condition of life; who maintain existence by being able to sense movement of prey to be caught or enemies to be avoided.

A further reason for attention to gesture or movement, of a social nature, is found by studying the expressive movements in man and those animals which are able to interpret the meaning of various signals expressive of psychic states. Certain herds of wild animals and flocks of birds station out sentries while the remainder feed; at the approach of danger a signal is given which is understood and responded to by the other members. In general the higher animals are able to give expression to their emotions through certain movements analogous to those made use

[1] Kuelpe: Outlines of Psychology, p. 363.

of by man. Darwin[1] has commented on the significance of these movements, showing, in the case of man, that he was first a gesticulatory animal, and that, as is still the case with animals, the first gestures were of an instinctive emotional nature. "There is no doubt," says Mosso,[2] "that the first human beings were dumb, and that men for a long time made use of gesture language for purposes of mutual understanding before they discovered sound language. The child, too, before it is able to talk expresses itself by gestures. It observes the looks of its parents and of the persons who speak to it in order to comprehend the meaning of the words heard."

At the second stage, following Wundt's classification, are the mimetic movements expressive of qualitative feelings. The type is readily recognizable in the taste reflexes corresponding to sour, sweet, saline and bitter impressions, On the third level we have pantomimetic movements expressive of ideas, capable of designating the object of an emotion, or describing the object as well as the processes connected with it by the form of the movement. As regards the subject of attention to gesture this third group is of greatest importance. Speech is genetically derived from gesture, at any rate it is safe to say that articulatory language arose as an accompaniment to gesture. "As evidence for this view we have the unrestrained use of such gestures by savages, and the important part they play in the child's learning to speak."[3] Mallory has declared that gestures in the wide sense indicated, of presenting ideas under physical forms, has had a direct formative effect upon language; and that "they exhibit[4] the earliest condition of the human mind, are traced from the remotest antiquity among all peoples possessing records; are generally prevalent in the savage state of social evolution; survive agreeably in the scenic pantomime and still adhere to the ordinary speech of civilized man by motions of the face, hands, head and body, often involuntary, often purposely in illustration or for emphasis."

The facts cited show a reason for attention to movements of gesture, the effect of which has been to engraft the reflex on the nervous system.

(*b*) *Patter.* The "boniment" or "patter" is the story told by the performer. It is the verbal clothing, in fact the "*mise en scene*" by which an illusion is given an appearance of reality. Talleyrand remarked that "speech was given to man in order to disguise his thoughts."

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[1] Darwin: Expression in the Emotions in Men and Animals.
[2] Mosso: Clark University Lectures, 1899, p. 393.
[3] Wundt: Outlines of Psychology, p. 300.
[4] Mallory: Sign Language of North American Indians, First Annual Report Bureau of Ethn., p. 285.

This is, at least, its use in the case of the diplomat and the magician. Of each of these it is true that "he says what he does not do, he does not do what he says, and what he actually does he takes particular care not to say anything about."

When a conjurer invents a new trick, he generally composes at the same time a special patter to accompany it. This must be memorized carefully, however ready a speaker the magician may ordinarily be. Such is the testimony of all the conjurers who have written on the subject: Houdin, Hoffman, Garenne Sachs, etc. The reason for this is similar to that for the practice of gesture. Speech is a form of motor expression. It is fundamentally an impulsive act and tends to appear in connection with gestures, as in all probability it had its development by a process of differentiation from gesture. Truth-telling is the natural mode within the tribe, whether among animals or men, as a consideration of mimetic, pantomimetic, and other expressive movements shows. The conjurer if giving way to the natural tendency would suit the word to the action. In reality he forces himself to talk glibly of the trick in a misleading way but with all semblance of truth, else will the trick fail in its effect. He therefore speaks by rote one set of words, while his thoughts which would ordinarily be given vocal expression in accompaniment with the performance, direct the real act which is taking place behind all this feint of hand, eye and patter.

Two not wholly separable elements of the misdirection of attention found in the spoken portion of the conjuring illusion may be seen from the foregoing presentation. (1) The power of vocal expression as mere gesture to call the eyes to the performer's face thereby lessening the force of attention to the act being performed. (2) By means of the suggestive power of the ideas in the patter to so shunt off the mental processes as to facilitate the trick. Examples of the first are seen in the way the performer springs a joke at the critical stage and thus makes for himself a favorable opportunity. When a card has been chosen and returned to the pack the artist does not at once make the pass to get possession of the card, as that might arouse suspicion, but after a moment he says to the chooser: "Are you sure you will recognize the card again?" All eyes are then involuntarily raised to his face for an instant, but in that instant the pass is made by a slight movement, at best almost imperceptible, and the card transferred to the top where it may afterward be disposed of as the trick demands.

The second offers a case of greater complexity. The significance of the words themselves are here of great importance in inducing the audience to attribute effects to other than their true cause; hence a feat of dexterity must be attributed to

mechanism or science and a trick really depending on scientific principles offered as a result of sleight of hand. This phase of the patter is indeed in many cases an accommodation to the apperception of the audience and will be further discussed in a succeeding chapter.

So far the discussion has pertained chiefly to passive attention, the aspect exhibited by untrained animals and men in a naïve state. Active attention may be brought into play, however, by the observer of the feats of the modern conjurer, for unlike the spectators of ancient magic he is conscious that he is being deceived and may make an effort to solve the problems presented. Dessoir[1] states that "the ignorant are more difficult to deceive than the educated. The former sees in every 'tour' a mistrust of his intelligence, an attempt to dupe him, against which he fights with all his might, while the latter gives himself up willingly to the illusion as he came for the purpose of being deceived."

Psychologically this means that the man of education gives only passive attention to the succeeding phases of the trick, while in the case of the ignorant person there is a struggle between active and passive attention. That the ignorant man is harder to deceive, however, may be questioned, and for two reasons. In the first place, recalling the monoideistic character of attention, it is a truism that attention to one thing means inattention to others, and that the very intensity of effort in one direction weakens effort in others. Now the conjurer always takes good care to do the other thing. Second is the difference in capacity for understanding the nature of the feat in the two classes. A large majority of the illusions require for solution more of an apperceptive basis than the ignorant man possesses; besides in many cases some lingering belief that 'there 's magic in it' stands in the way of a proper understanding of the trick. However, the performer prefers passivity and a non-critical state and seeks in every way to guard against the rise of active attention. He observes the rule "never to reveal in advance the nature of the effect to be produced," in order not to focus attention. For example, where an article is to be made to disappear after counting one, two, three, the change is made at the one or two, as the minds of the audience are actively centered on the three and do not notice what takes place before that. The same reason holds for another conjuring rule: "never to repeat the same trick twice in one evening unless the manner of performing it is varied."

We may summarize this section with the observation that the fixed mental habits, evolved for useful purposes, to avoid being

[1] Dessoir: The Psychology of Legerdemain. Open Court, Vol. VII.

surprised and deceived, are the very agents employed by the conjurer to effect this end.

2. *Perception.* Certain aspects of attention have been presented in the preceding section. In some of its phases attention is inseparable from the discussion of all conscious processes, hence a treatment of perception is at the same time a treatment of attention. In the succeeding discussion of the perceptive processes, therefore, we merely shift the point of view, emphasizing for the time the effects produced through stimulation of the sense organs, with the subjective modification these products undergo.

Perceptions are combinations of sensational and ideational elements. The latter are complexes built up for the most part from sensations previously experienced. In an unusual degree conjuring offers opportunity for the study of these elements as they enter into the phase ordinarily called apperception. In no other field, perhaps, is the part contributed from past experience, or in Professor James's phrase the part which "always comes out of our own head" so large. Perception refers to concepts. Apperception depends on the contents of the mind as conditioned by the past life. The new is interpreted in terms of the old and in accordance with habits of mental action previously formed. In this tendency of the mind to act in certain habitual lines corresponding to the law of mental economy is found the key to a large part of the illusions of conjuring. The magician is skilled in appealing to the strongest apperceptive centers of his audience. The history of conjuring, as of human deception, generally reveals how advantage has always been taken of the prevailing thought of the community. The priestcraft of the nations of antiquity in their thaumaturgical operations to acquire power relied on the superstitious fancies of the people to give a miraculous color to the simple tricks of sleight-of-hand, the facts of true science, and all the means of imposture employed.

Serious magic as a mental prepossession has continued, though with ever decreasing intensity, to be a factor in conjuring down to the present time. When Descartes asserted that animals were mere automata he gave a new cue to the conjurers. While the public mind was vibrating with this idea, automatic ducks, swans and other creatures were introduced by the conjurers of the time, and continued in evidence for more than a century and a half. No one knew better than Houdin how to make use of this popular apperceptive element. His aerial suspension trick, as presented, gave the appearance of the subject, the six year old son of Houdin, sleeping in the air, with one hand supporting the head, and the elbow of the same arm resting on the top of an upright rod. The secret of the trick lay in the ingenious

mechanical apparatus concealed under the clothes of the child, and would have been easily guessed had it been presented in a bald form devoid of its apperceptive stage-setting. But as given by the magician it was the "suspension in equilibrium by atmospheric air through the action of concentrated ether." Surgery supplied him with the idea. He says "it will be remembered that in 1847 the insensibility produced by inhaling ether began to be applied in surgical operations; all the world talked about the marvellous effects of this anæsthetic and its extraordinary results. In the eyes of many people it seemed much akin to magic." "The experiment was received with hearty applause. Still it sometimes happened that sensitive persons, regarding the etherization too seriously, protested in their hearts against the applause, and wrote me letters, in which they severely upbraided the unnatural father who sacrificed the health of his poor child to the pleasures of the public. Some went so far as to threaten me with the terrors of the law if I did not give up my inhuman performance." All this testifies to the completeness of the illusion. The public mind was so filled, at this time, with the quackery of mesmerism and the magical possibilities of ether that they were prepared to believe in the ability of a person to sleep in the air, without other support than the upright rod on which the sleeper's elbow rested, rather than suspect the existence of concealed mechanism. When the ether story later became threadbare the feat was introduced as an effect of electromagnetism. The manner in which the conjurers appeal to topics of popular interest to lead the public to a wrong interpretation of a trick is illustrated in the modern fashion of presenting every feat admitting of it in a garb of pretended hypnotism.

We now pass from the general view of apperception to a consideration of particular phases of it better termed preperception. In this case the ideational element is seen to be more definite, and is, in a measure, called up at the will of the performer.

The centrally excited portion of the perception varies with the individual and with the character of the stimulus. In common with the sensational elements from the peripheral organs, it possesses among its attributes quality and intensity. The relation which these bear to the corresponding attributes of the products of the sense-organs have been made the subject of investigation. Münsterberg[1] has found that if a word is displayed for a brief time which presents some slight difference from another word, it is read as though this difference were not visible, provided that a word is previously called out to the observer which stands in intimate association to the other, but has nothing to do with the actual impression. Thus, "part"

[1] Münsterberg: Beiträge zur Experimentellen Psychologie, Heft. 4.

is read as "past," if future is suggested, "fright" as "fruit," if vegetable is given. The effect is a probable result of the excitement of the ideational centers from first attending to the class. Similar results have also been found by Pillsbury.[1]

Kuelpe[2] in his study of illusory perception obtained judgments of subjective and objective illumination of a dark surface. "The observer sat at his ease in a darkened chamber, and was required to say whether he saw anything, and if so, what it was like, and whether he thought it was objective or subjective. The only objective phenomenon introduced was a faint illumination of the dark wall facing the subject, given at irregular intervals, for various periods of time, and at different degrees of intensity. Nearly all the observers were liable to confusion when the stimulus approached the limen; an objective was very seldom subjectified, but a subjective frequently objectified." The experiments showed that the extent of stimulation over which confusion is possible is very small, and that the normal intensity of the centrally excited visual sensations is therefore exceedingly weak.

It is plain, however, that cold-blooded experiments in a laboratory can give little idea of the mental contribution made in the case of an imaginative person whose centers are quivering with emotional excitement. In the conjuring illusions much of the effect lies in the anticipatory preparation of the ideational centers concerned with the object of attention, the performer determining what preparation shall be made.

On the fact that we act with certainty on our knowledge of the phenomenal world rests the ordinary conviction of the identity of things as they are and as they appear to the observer. Ages of response to this idea have rendered our trust in the senses so implicit, and given such fixed mental habits, that numberless errors and illusions, historical and personal, fail to shake our confidence. An obvious inference may be drawn from the diversion of attention mentioned in the last section. Beside the mere switching aside of the sensorial attention by gesture, as noted, the awakening of new images by means of the patter is equally as important. The fire of witty talk, the evocation of spirits, cabalistic signs, attribution of power to wand, etc., are all effective. A reason for attributing scientific effects to sleight of hand and the reverse will now more plainly appear. A simple trick is that of causing a coin to instantly dissolve when put in a tumbler said to contain a powerful acid. The coin is palmed and a substituted glass disk is dropped into the water beneath a handkerchief, profes-

[1] Pillsbury: A Study of Apperception. *American Journal of Psychology*, Vol. VIII, No. 3.

[2] Kuelpe: Outlines of Psychology, p. 184.

sedly used to prevent acid fumes from arising. The spectators, always prone to adopt a complicated hypothesis, hearing as they believe the chink of the falling coin, and being given the idea that acid is at work may overlook the more simple explanation. The chief part of conjuring lies in the artist's ability to so lead the thoughts of the audience into chosen paths, to awaken at the proper time such new images that the development of the trick appears for the moment as the logical outcome of the surrounding conditions; then by the production of a result totally unexpected and at variance the sense of illusion is produced. Nothing is neglected which may assist in this result. In arranging the programme each trick is made more surprising than the last. Every effort is made to so fill the mind with a feeling of the wonderful, and so far as possible with special ideas, that the imagination is ready to respond in the next step taken. Conjuring is thus seen to be a kind of game of preperception wherein the performer so plays upon the psychical processes of his audience that the issues are as he desires.

The perception which occurs under conditions of vivid expectation shows how the inward reproduction may completely dominate the sensory element and create a product of the imagination in intensity rivaling reality.

Where the nature of the object which is expected to appear is known in advance, anticipatory preparation may then have ready a preformed image to spring at any instant of time. An analogy is that of the person whose mind is so superstitiously primed that any white tree-trunk or post will explode the ghost centers. The principle that one sees what one expects to see, finds, perhaps, its best exemplication in the conjuring shows of the materializing medium. It is difficult for the scientist to read himself into the peculiar state of mind of the "sitters" who firmly believe that the spirit of their departed friends are really with them in the room, and who, by having their intelligence paralyzed by a belief in the supernatural, are easy marks for the charlatans who, despite frequent exposures, are continually springing up to take advantage of human frailty. Much of the effect is accounted for when the "*mise en scene*" is held in remembrance: everything is so disposed as to contribute to an atmosphere of mystery. A darkened room; a circle of suggestible subjects infecting each other, and all strained to the highest pitch of vivid expectation: their psychical centers hyperæsthetically excited by the desire to learn of their loved ones whose images fill the mind, and whose actual presence is felt. These are not conditions conducive to sharp sight and logical judgment, but they make the work of the medium easy. In this abnormal state of the subjects the sensorial is almost at the

mercy of the preperceptive element. Any rustling noise is attributed to spiritual agency; every light reflection is taken for a spirit form. The literature of the subject is full of illustrations. The author of "Revelations of a Spirit Medium" who confesses that by his skill in the performance of his feats he has converted hundreds of people to a belief in spiritualism, giving them undoubted evidence of life beyond the grave, states that when beginning the practice of cabinet tricks before a circle of spiritualistic friends in his apprentice days he noted their proneness to attribute every slight occurrence to spiritual agency. A handkerchief illuminated by phosphorus on being pushed through the opening of the cabinet was seen by the sitters as a human head and face. "It was set down as a case of etherialization,[1] as they declared they could look right through it and see the curtain behind it. One gentleman, a doctor, declared he could see the whole convolutions of the brain. Thus they helped out the show with their imaginations and made a reputation for the medium." He learned later that by putting a wire gauze mask in front of the handkerchief a luminous face and head was presented. He recounts that "that wire mask has been recognized by dozens of persons as fathers, mothers, sisters, brothers, cousins, sweethearts, wives, husbands, and various other relatives and friends." The same author, alluding to the tendency to allow the imagination to dominate what is seen, after describing an easy process for producing spirit pictures by transferring outline pictures to a slate, states that he "knows[2] of, at least, five people who have recognized friends in Lydia Pinkham's newspaper cut after it had been transferred to the medium's slate." Not to multiply needlessly examples illustrating how the perceptions are determined by the intensity of the interest—Dessoir[3] quotes the case of a scientist who had difficulty to restrain himself from laughing when he "heard the same puppet successively addressed as 'grandmother,' 'my sweet Betty,' 'papa,' and 'little Rob.'" Reflecting on this propensity of the mind he acutely observes, "create a belief and the facts will create themselves."

3. *Suggestion and Association.* The part which the accompanying images play in the perceptive process has been set forth. Under the above heading will next be shown how the performer manipulates these ideas in the minds of his audience, juggling with them much as he does with the articles he handles. Suggestion is the switching-key by means of which he ushers in the ideas necessary to his purposes.

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[1] Revelations of a Spirit Medium, p. 90.
[2] *Ibid.*, p. 147.
[3] Dessoir: The Psych. of Legerdemain, Chap. V, Open Court, Vol. VII.

Several aspects of normal suggestion are related to our subject.

1. *Suggestions of Repetition.* In a certain class of tricks the following conjuring rule applies: "First actually do what the spectators are to be led to believe you do." In these cases the conjurer prepares the way by the formation in the minds of the spectators of proper associations. In the well-known trick of firing from a pistol the broken pieces of several borrowed rings this is the principle involved. The pistol is fired at a box placed on a stand. The box is then unlocked and a second locked box taken from this containing a third, and so on,—finally reaching the last of the series of boxes which, when unlocked, contains the rings tied to roses. In one form of the trick the rings are not in the series of boxes at all, but after the artist has demonstrated that the second has been taken from the first and the third from the second, etc., it becomes easy to take the casket containing the rings from the shelf behind the table, where the assistant has placed it, by lifting it up as though from the preceding casket. By the first steps the association is formed so that no doubt is felt that the rings were really in the nest of boxes. Another element entering here is found in the general tendency to short-circuit all possible processes. After the first or second time the people become impatient, as always at repeated action, and relax in keenness of attention, and if the performer seems to hurry later it is in line with the desire of the audience. In the Chinese ring trick, by giving certain rings to be examined, receiving them back and adroitly giving them out again the artist manages to create the impression that all have been examined, and the effect upon the spectators is all the more startling by reason of the eight rings shown by inspection to be without opening, later linking themselves together in various combinations in the hands of the performer. The possibilities of illusory perception under the influence of suggestions of repetition may be well illustrated by a portion of a sleight-of-hand trick given in some detail. The effect of the trick known as "A Shower of Money" is as follows: The performer borrows a hat which he holds in his left hand. He then announces that he requires a number of (say) half dollars for the purposes of his trick, but, he continues, "as there seems to be a good deal of money around to-night I will not be at the trouble of borrowing, but just help myself." He then begins to pick the coins out of the air, finds one climbing up the wall, another in a spectator's whiskers, under a lady's foot, and so on. At each supposed new discovery the performer takes with his right hand, from some place where there was clearly nothing an instant before, a coin which he drops into the hat held in his left hand. The explanation of the trick is very simple,

being merely a practical application of the art of "palming." The performer provides himself beforehand with the number of coins he desires for his experiment. "Of these he palms two in his right hand and the remainder in his left. When he takes the hat he holds it in the left hand, with the fingers inside and the thumb outside, in which position it is comparatively easy to drop the coins, one by one, from the hand into the hat. When he pretends to see the first coin floating in the air he lets one of the coins in his right hand drop to his finger tips, and, making a clutch at the air, produces it as if just caught. This first coin he really drops into the hat, taking care that all shall see clearly that he does so. He then goes through a similar process with the second; but when the time comes to drop it into the hat, he merely pretends to do so, palming the coin quickly in the right hand, and at the same moment letting fall into the hat one of the coins concealed in his left hand. The audience perceiving the sound, coincident with the movement, naturally believe it to be occasioned by the fall of the coin they have just seen. The process is repeated until the coins in the left hand are exhausted. Once more the performer appears to clutch a coin from space, and showing for the last time that which has all along been in his right hand, tosses it into the air and catches it visibly."[1]

When the artist really throws the first coin into the hat he leads the spectators to infer the same result from the subsequent similar movements. The chink of the falling coin strengthens the illusion and the ostentatious catching of the final coin clinches it. To still further mystify the audience and to remove the suspicion that the coins were all along concealed in his hand, the performer sometimes uses his producing wand, which is so made that on pressing a little stud a slit coin springs out on the end, giving the effect of having been taken out of the air. It is used in connection with the money slide, an apparatus for holding money concealed under the vest. The hand can now be shown empty, but by pressing on the side with the right hand at the same instant a coin is made to appear on the wand, which he can then do unobserved, he obtains the needed coin. Under cover of taking the coin from the wand he withdraws it into the wand and shows the one in his right hand, which is thrown into the hat. He can then repeat. Where the same result can be produced by two wholly different methods the effect on the audience is most bewildering, as any conjectures as to the explanation of the first method are inadmissible as regards the second.

Several investigations have been made in the subject of sug-

[1] Condensed from Hoffmann's Modern Magic, p. 205.

gestions of repetition. Binet[1] and Henri have experimented to see with what degree of precision a person repeats the same operation where the circumstances which have explained the first operation change a little and require a different act; but where the suggestion remains that the conditions are as at first. The experiment was based on the visual memory of lines. A model line was shown to a child, then after the lapse of a certain interval, a card was shown on which was traced a series of parallel lines of increasing length; the child had to recognize the line equal to the model line. The operation is made two times; the first time the model line is found in the series, the second time it is not found. Thus, the model line being 40 millimeters, the second series contains no line longer than 36 millimeters. A practiced eye would perceive the lacuna, but the first trial has already created a habit by reason of which the child, having found the model line in the first table, strives to find it in the second. In children from 7 to 9 years old, 88% were misled by the "routine:" from 9 to 11 years, 60%; and from 11 to 13 years, 47%, thus showing that suggestibility decreases with age.

Seashore used somewhat analogous methods in investigating the subject. His experiments, made upon university students, seem to prove them not less easily duped than the children of the primary school mentioned by Binet. And it is important to observe that even where his subjects acted with knowledge they were still subject to the illusion. His manner of procedure was to make a genuine experiment several times, then, when the association has been formed by repetition, a pretended experiment is made and the subject by reason of the suggestion responds as before. In illusions of heat produced by first sending an electric current through a silver wire held between the fingers of the subject, and finally pretending to do so, of 420 trials there were only five cases where the subject felt nothing. Illusions of change of brightness were produced by the principle employed by Kuelpe heretofore mentioned, with the exception that at a given signal a change of intensity of the illumination was first made.

Complete hallucination[2] of an object was produced in the following manner: In a darkened room a little ball is hung upon a black background and the distance at which the subject can distinguish it is ascertained. The experiment is made several times, the subject approaching slowly and pausing at the point where he can just see the ball. The distances marked on the floor are then read. He then turns back to

[1] A. Binet: *La Suggestibilité. L'année Psychologique*, 1898, p. 136.
[2] Seashore: Measurements of Illusions and Hallucinations in Normal Life. Studies from the Yale Psych. Lab., No. III, 1895.

make the trial again; at this instant the operator suppresses the ball; the subject advances again and when he finds himself at the same distance as at the previous times he believes that he perceives the ball. The point of importance here, as Binet has pointed out, lies in the light it throws on the mechanism of suggestion. The fact that subjects acquainted with the purpose and nature of the investigation, after several repetitions of the stimulus, undergo the illusion, seems to show that the greater part of the effect lies in the tendency to re-excite the centers that have just been in action.

There is a well known conjuring illusion which closely parallels the experiment last given. In this case, however, the image of repetition seems in part to be the effect of an after image. The reference is to the trick of causing an orange, ball, or card to disappear in the air. The performer shoots several cards out into space; sending some of them even seventy or eighty feet up into the gallery. Finally a card starts out but is seen to vanish while in mid-air. The thrower has in truth repeated the usual casting movement but has thrown no card. What the audience see is an image of repetition which is undoubtedly partly the effect of a residual stimulation in the eye, partly a central excitation. For, since a frequently repeated sensory irritation, as well as the external suggestion of the motion of the hand, is necessary to awaken the image of the object associated with the movement it cannot be classed as purely central and hence is not an hallucination. The conjurer by first really throwing up the card gives the suggestion of repetition and following it up by the pretended throw causes the subject to see what he desires. We have produced this effect in some experiments made with a tennis ball (an apple and a silver dollar were found equally effective, however). The experiments were performed before the pupils of several schoolrooms, also on a number of children and adults not included in the results below. The operator sitting behind the teacher's desk threw the ball about three feet in the air, catching it and letting the hands sink low behind the table. The second throw was four or five feet in height. On its return it was dropped between the legs but the hands went up with the regular throwing movement and were held as if awaiting the descent of the ball.

The conditions for the experiment offered by the open schoolroom were not good, the light was too strong. From other trials made in the evening on people of all ages it seems that dim or artificial light is more suitable to the production of the illusion. This view is warranted also by the fact that after-images are of longer duration in dim or artificial light. Observation shows

also that the colors on a rotating disk fuse at a slower rate of rotation in a feeble light.

After the performance each pupil was requested to write a description of what he saw and to state where the ball was when he ceased to see it. Two seventh grades, one fifth and one fourth grade were visited. Of the 165 children witnessing the experiment 78 answered to seeing the ball go up and disappear. Of the whole number 103 were boys and 62 girls. 40% of the boys and 60% of the girls were deceived in the matter.

A few typical answers are herewith presented:

1. I saw it come two times. It was about half way up to the ceiling before it disappeared.
2. I saw it come down, but not the last. It was about one foot.
3. I did not see the ball come down. It was half way to the ceiling before it disappeared.
4. I did not see the ball come down, but I think it did.
5. The ball did n't go up as far as the door before it disappeared.
6. I did not see the ball come down. The ball went about one-fourth to the ceiling before it disappeared.
7. It was about one yard from the ceiling before it disappeared.
8. The last time the ball was going to come down it disappeared.
9. The ball went in back of the picture on the wall.
10. I do not see what became of the ball. All I can think of is it went up into the air and did not come down, or, at least, I did not see it.

From the answers given it would appear that the intensity of the central image varied with the individual. Many answers were ambiguous to such an extent that it could not be said whether the ghost of the ball was seen at all, or whether it was not seen to make a part, at least, of the return journey. A number try to account for the mystery. Such explanations are offered as that it was a rubber ball and burst while up in the air.

The fact that 20% more of the girls than of the boys saw the phantom ball may have many causes. The cases are few. We may, in passing, however, quote Havelock Ellis's[1] statement to the effect that ecstacy, trance, seeing of visions, illusions of fancy and tendency to hallucinations, are more frequent in females. Pliny tells us that women are the best subjects for magical experiments, and Bodin estimated the proportion of witches to wizards at not less than fifty to one. It is certain

[1] Havelock Ellis: Man and Woman, Chap. XII.

that in numerous trials of this experiment before ladies not one failed to experience the illusion, and even previous knowledge does not prove a sufficient safeguard.

These cases of suggestions of repetition cited, both from the laboratory and the stage, show plainly that the conjurer's maxim "to first really do what you would have the audience believe you do" rests upon a physiological basis.

We turn now from suggestions of repetition to psychic phenomena of a somewhat different though still related type. In suggestions of confidence and obedience—in the natural tendency of the mind to be influenced by means of a hint, sign or symbol, an association or kindred stimulus the conjurer finds a ready means for betraying the judgment of his audience. The two factors to be considered are (1) the conjurer as a suggester of ideas, direct or indirect, as means of influencing the mind, and (2) the mental condition of the audience.

The chief quality to be inspired is confidence, and the peculiar confidence the artist inspires is a general belief in himself as a performer of wonders. As a background for the special demands he makes upon their credulity pains are taken to create a magical atmosphere. Coming upon the stage to begin the entertainment he removes his gloves and rolls them into invisibility. Instead of borrowing articles for the purpose of his trick he may produce them from the nose or beard of some one in the audience. Each trick is made more startling than the last, and each becomes the pedagogical basis for another till finally the spectators, lost in the bewildering complexity of wonders, react helplessly to the suggestions of the performer, which he helps out by the pretended evocation of imaginary spirits, by cabalistic words, proper use of the wand, in effect, by the artist living up to the dramatic possibilities of the role of magician.

The second point, relating to the suggestibility of the audience, may be illustrated by a brief notice of the investigations of various workers in this field. In these cases, belief that the fact will happen, instead of being instituted by repetition, is brought about by the idea being given by speech, gesture or implication.

Small[1] tested the power of suggestions of this class to modify the perceptions of school children. He found that after some preliminary remarks on odors, in which several kinds were mentioned, and having placed labelled perfume bottles on the table, when he made a spray in the room of water from an atomizer, 73% of 540 children got an illusion of perfume. In experiments of tastes with sugar, salt and quin-

[1] Small, M. H.: The Suggestibility of Children, The *Ped. Sem.*, Vol. IV, No. 2.

ine solutions, after the preliminary suggestions, 88% gave judgment that the water was sweet, 95% got the illusion of salt and 90% perceived the taste of quinine in the water. In many cases they accompanied their judgments with the characteristic mimetic movements; the last being most marked in effect, many making the "bitter face." When a crank was turned, to which a toy camel was attached by a string, 76% of 381 pupils saw the camel move although it never did. The effect of the suggestions made in these experiments was invariably greatest in the lowest grades.

The result of suggestions made in a tone of conviction or authority, has interest for our study as being most nearly in line with the conjurer's practice. A hint of any description, coming from one who ought to know, in general, produces a marked effect. A. Binet[1] in collaboration with V. Henri, has made experiments of this class to show the effect of moral authority in influencing an act of memory. A model line of 40 millimeters in length was presented to a child, who had then to find it again by memory, or by direct comparison, in a table composed of several lines among which was to be found the model line. At the moment of making his choice, the operator regularly asks him and always in the same tone, the following question: "Are you very sure? Is it not the line by the side of that?" Under the influence of this discreet suggestion, made in a very gentle tone, the majority of the children abandoned the line first designated and chose another. The table of results given by him shows that the youngest are most sensible to the suggestion, and further, that the suggestion is more efficacious when the choice is made from memory than when made by direct comparison.

The aim of the experiment was to determine the mechanism of suggestibility and to study the conditions where it succeeds best. As a result of his tests, the author deduces the rule that "the suggestibility of a person upon a point, is within reason, inversely as the degree of certainty relative to this point." Vitale Vitali[2] who repeated these experiments, insists upon the importance of the personality of the experimenter, a factor which will cause great variation in the results.

Having repeated after some time the same tests upon the same subjects, he has found enormous variations.

Perhaps the closest analogy to the conditions in the audience of the conjurer, is found in some later experiments of Binet[3] and Vaschide upon 86 pupils of the French primary schools.

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[1] Binet: La Suggestibilite, L'annee Psychologique, 1898, p. 95.
[2] Vitale Vitali: Studi Anthropologici, Forli, 1896, p. 97.
[3] Binet: *op. cit.*, p. 98.

The experiment was intrusted to M. Michael, the director of the school. He alone did the speaking and explaining. After the preliminary distribution of paper, writing of names, dates, etc., he announced that he was going to make an experiment upon their memory of the length of lines; a line drawn on a white card was then shown for three seconds to each pupil, and each one had then, after having seen this model, to trace upon the paper a line of equal length. This having been done M. Michael announced that he was going to show a second line a little longer than the first; this declaration was made in firm well modulated voice, with the natural authority of a director of the school addressing the whole class collectively. The second line was only 4 centimeters, whereas the first was five. The second line was shown to each pupil exactly as the first had been. The suggestion was very effective. Nine pupils only of the 86 drew the second line shorter, or it can be said that 75 believed in the word of the master rather than to the truth of their own memories. The author asserts as the result of the test that normal suggestion constitutes a test of docility, and cites the facts given by Bernheim as showing that the persons most sensible to hypnotism, that is to authoritative suggestion, are old soldiers, government employees, and, in a word, all those who have been habituated to discipline. The children are in the passive state when they follow readily ideas suggested by any one in authority over them, or, indeed, any one who can impress them. To a large degree this receptivity is maintained throughout life. It is not children alone who are in subjection to ideas. Moll[1] says "men have a certain proneness to allow themselves to be influenced by others through their ideas, and, in particular, to believe much without making logical conscious deductions." We are all credulous and ready to accept the answer. It is only more noticeable at conjuring shows than at other assemblages. In community life there is need of exchanging ideas, and while our experience may in time render us more critical of our fellows the tendency still persists to take as truth ideas advanced from whatever source. This tendency is greatly accentuated in a crowd, hence the reason for another maxim in conjuring: "always perform to as large an audience as possible." "The mental quality of the individuals of the crowd," says Le Bon,[2] "is without importance. From the moment that they are in the crowd the ignorant and the learned are equally incapable of observation." This is proved by a great number of historical facts, and is illustrated in the action of every mob. In this subversion of the rational element the conjurer finds his

[1] Moll, A.: Hypnotism, p. 219.
[2] Le Bon, G.: Psychologie des Foules, p. 28.

advantage. He assumes great audacity and boldness and a firm belief in himself. These are the qualities which a leader must possess who would sway the people and subject them to his purposes.

Were the spectator in an ordinarily critical state he would know very well that blowing on a card is not an adequate cause for transforming it into another; nor the ruffling of a pack of cards a probable means for making a chosen card fly from the pack to stranger's pocket; nor the varied use of wand and word and by-play a sufficient explanation of the effects produced; yet he sees the fact and his mind unconsciously follows the suggestions so artfully offered him. He is not at his best intellectually. The rational element is in abeyance.

The suggestibility of the normal state here exemplified finds analogies in the negative illusions of hypnotism. Under hypnotic suggestion the subject does not perceive an object which is present before him. The same fact appears in the illusions of our study. It has been shown that the performer hides, produces or substitutes objects under the very eyes of the spectators, the attention being first drawn off by clever talk or feints of movement. For example, in the card metamorphosed the change is made in the spectator's field of view—the sense stimulation takes place, but does not become focal because he has been psychically blinded by withdrawal of attention. In hypnosis, in order that the subject may not see the object which he is told is not present, another factor, according to Binet[1] and Féré, must be added to the diversion of attention; before it can be attained the conviction that the object is not there must be first established in the subject, without this the result would hardly be attained. It is a certain fact, observable without hypnosis, to which attention was called while on the subject of preperception that strong expectation of an effect is very favorable to its appearance.

A difference to be noted is that, whereas, in hypnosis the object is not seen only when the operator forbids, in waking life to forbid the perception of an object insures its being seen.

Again, experiments in hypnotism indicate that the suggestibility of a hypnotized individual increases with the number of hypnotizations, but Binet has shown in the work above referred to that a second suggestion is less efficacious than the first, and this offers a second reason for the rule of the prestidigitator: "Never repeat a trick twice in the same performance unless by a different method," for beside focussing attention in advance the force of the suggestion for diversion will be weakened.

4. *Suggestion and the Law of Economy.* Another large group

[1] Binet and Féré: Animal Magnetism.

of tricks in which the conjurer takes advantage of his superior knowledge of the mental habits of the audience remains to be studied. Chief among them are those in which is seen the universal tendency to do the thing required in the easiest way. The importance of this law in the explanation of a type of suggestion will become clearer as we proceed. Some cases of "forcing" will illustrate this phase of suggestion. By the term "force" in conjuring is meant the whole process by which a person is led to choose such card, number or object as the performer desires—the subject all the while believing that he is exercising absolute freedom of choice. The success of many tricks depends on this feature which is accomplished in various ways. Some simple cases of forcing which are worthy of recital only because of the background of bewilderment they prepare are given before entering more at length into those possessing greater psychological complexity.

Where it is desired that a certain number be chosen the forcing bag is frequently employed. This is a double bag; on one side is contained counters from one up as far as desired. On the other side the counters are all of a kind. The magician brings out a handful from the first compartment to show that all are different, and then asks some person to place his hand in the bag and choose one, offering him as he does so the other opening.

A person may be asked to thrust a paper knife between the pages of a closed book. In this case all the pages are numbered alike, the book being so made up that at whatever point the knife is inserted the number of the page is the one desired.

The following force was used by Hermann in an anti-spiritualistic slate-writing trick: two slates after being washed with a sponge were tied together and handed to a spectator to hold over his head. Nine people in the audience were given slips of paper on which to write questions. These were then folded up and dropped into a hat. A lady chose one from the hat. It was read, the slates untied and an answer to it found on one of them. Hermann explained that he had suppressed the nine questions written by the people in the audience, and had dropped in nine of his own all containing the same question, hence the lady could not help taking the one desired for the trick. There had been a false flap on the lower slate, which he had dropped out when they were being tied, and the answer was there before the questions were written.

In a number of feats, of which the Rice and Orange trick performed by Hermann is a representative, we have a form of forcing which contains another element of psychological interest. In this trick rice and orange are made to exchange places. We give a somewhat detailed account of it that the

full effect of the trick may be seen, following in the main Hoffmann's[1] description. The apparatus consists of three japanned tin cones about ten inches in height by five at the base, and an ornamental tin or zinc vase standing about the same height as the cones, and having a simple metal cover or top. Of the cones, all of which are open at the bottom, two are hollow throughout, but the third has a flap or movable partition half way down, inclosing the upper half of the internal space. This flap works on a hinge, and is kept shut by a little catch, which is withdrawn by pressure on a little button outside the cone, when the flap drops down and lets fall whatever has been placed in the enclosed space. The cone is prepared for the trick by filling this space with rice, and closing the flap; and the three cones are then placed in a row on the performer's table, the prepared one being in the middle. The vase contains in its bottom, a valve, which leads into a false bottom in the foot beneath. The vase is prepared for the trick by placing an orange in it, and in this condition it is brought forward and placed on the table by the performer or his assistant. A small paper bag full of rice is brought in at the same time, and completes the preparations. The performer begins by borrowing two hats, and places them one on the other, the mouths together, on a chair or table. He then (by palming) produces an orange from the hair or whiskers of a spectator and places this on another table. He next brings forward and exhibits the vase, filling it as he advances, with rice from the paper bag, and thus concealing the orange which is already placed therein. He calls attention to the genuineness of the rice and the simplicity of the cover, and finally putting on the latter, places the vase on the ground or elsewhere, in view of the audience. He pretends a momentary hesitation as to where to place it, and in the slight interval during which he is making up his mind he presses up the button within the foot. This opens the valve allowing the rice to escape into the space below, and leaving the orange again uncovered. The audience is, of course, unaware that such a change has taken place. Leaving the vase for the moment, he requests the audience to choose one or other of the three cones on the table. It is essential to the success of the trick that the prepared cone containing the rice be chosen. It is then placed on the top of the upper hat, if it is the middle one and conjurers tell us that in such cases the middle one is nearly always the one chosen. The audience are then asked to make a choice of the remaining cones and the one selected is placed over the orange upon the table. The performer showing first by rattling his wand

[1] Hoffmann: Modern Magic, p. 340.

within it that it is hollow throughout, and he may even hand the remaining one around for inspection.

It was said that the audience almost always select the middle cone and the explanation given is based on that assumption.

But the question naturally arises, suppose one of the end cones is selected instead of the middle one, the trick is spoiled as neither of the others will produce the rice. But such is not the case, for mark, that the audience have not been asked to choose which cone shall be placed on the hat, but simply to choose one of the cones. Had one of the end cones been chosen it would have been handed around for examination and finally placed, not on the hat but over the orange. Then, standing behind the table, he requires the audience to make a choice between the remaining two, right or left. Whichever is chosen he is safe. As the right of the audience is the performer's left, he is at liberty to interpret the answer in whichever way he thinks proper, and he does so in such a manner as to designate the cone containing the rice. Thus, if the audience say the left he answers, "on my left? Very good." If they choose the right he says, "on your right? Very good." In any case the cone containing the rice is taken as the one designated and is placed on the hat. As the audience have, to all appearance, been allowed perfect freedom of choice and have actually examined two out of the three cones, they are very unlikely to suspect any preparation about the remaining one.

The performer now raises the cone placed on the hat to show that there is nothing underneath it, and as he replaces it presses the button, thereby letting the flap fall, and the rice pours out upon the hat, though it remains still concealed by the cone. He next lifts up the cone under which is the orange, and holding the latter up, replaces it, but in again covering it with the cone makes a feint of removing and slipping it into his pocket. Then noticing, or pretending to notice, a murmer on the part of the company, he says: "Oh, you think I took away the orange, but I assure you I did not." The company being still incredulous, he again lifts the cone and shows the orange. "Here it is, you see, but as you are so suspicious I won't use the cover at all, but leave the orange here in full view on the table." He again leaves the orange on the table, but this time on what is called a "wrist trap." Leaving it for the moment he advances to the vase, and holding his hands together cup-fashion over it, but without touching it, he says, "I take out the rice, so, and pass it under this cover" (walking towards cone on the hat, and making a motion of passing something into it). "Let us see whether it has passed." He raises the cone and the rice is seen. "Perhaps you think, as you did not see it, that I did not actually pass the rice from the vase to the cone. At any rate

you will not be able to say the same about the orange. I take it up, before your eyes, so." He places his hands round it on the table, and at the same moment presses the lever of the trap, which opens and lets it fall through into the table, closing again instantly. Keeping his hands together, as though containing the orange, he advances to the vase, and holding his hands over it, says, "here is the orange which has not left your sight even for a single moment. I gently press it so" (bringing the hands closer and closer together), "and make it smaller and smaller, till it is reduced to an invisible powder, in which state it passes into the vase." He separates his hands and shows them to be empty, and then opening the vase, rolls out the other orange, and shows the vase empty, all the rice having disappeared.

There are here two points of psychological interest which, in the last analysis, however, are covered by the same explanation: 1. The reason the middle cone is oftenest chosen, and 2, why the performer can interpret the choice to suit his purposes with no suspicion of it on the part of the audience. That the middle of three balls, cones or other articles, should be oftenest chosen is a suggestion to make psychologists pause before placing the same reliance in the calculation of probabilities in mental phenomena that is possible in the realm of physical science. The ingenious explanation given M. Binet[1] by the conjurer, M. Arnould, is here quoted, with approval, as being in line with the correct explanation of a large part of the effect produced by the conjurer. He says: "The middle object is oftenest designated because it is the easiest to point out. In the experiment the performer and the spectator are face to face, if the object to the left is designated it will be necessary to add whether the left of the operator or the speaker is intended; as it requires but one word to designate the middle one he chooses that as more easy." Sidis[2] has made experiments analogous in principle to the performances under discussion; their end was to influence a person's choice who supposed himself free. On a large white chart were placed six squares of color, each having a dimension of three centimeters each way. A black screen covered the whole, and the subject was asked to fix his eyes on this for five seconds, then the screen being raised he has to choose at once any one of the squares of color he wishes. The objects being placed in the same straight line, various artifices are employed to influence the choice: (1) abnormal position: one square is placed slightly out of line or a little inclined; (2) abnormal form: one is made in the form of a star or triangle; (3) using a square of the same color as the screen; (4) suggesting a color verbally as

[1] Binet: *op. cit.*, p. 143.
[2] Sidis: The Psych. of Suggestion, Chap. III.

the screen is raised; (5) suggesting verbally the number in the row; (6) surrounding one square with a band of color. The three methods first named proved most suggestible in the order given. The percentage of successes being, to take only the cases of immediate suggestion, 47.8, 43 and 38.1.

In a work by Decremp,[1] a magician of the last century, is described a play, wherein a choice is directed when the number of objects is much larger. The performer spreads out before the audience fifteen packets of two cards, and asks them to think of any two by chance, now if he forms a packet of two notable cards of the same color, such as the king and queen of hearts, it will be more frequently selected than another, "for," remarks Decremp ingeniously, "it is easier to retain in memory the king and queen of hearts than two other cards poorly matched."

Here appears again the principle of inertia. Between several possible acts, where all are indifferent, that is unconsciously preferred which is easiest to perform. In some experiments by Binet in his work on suggestibility above referred to, these mental habits are brought out but they are too long to be quoted here. The same principle, however, appears in the different card forces now presented.

Forcing a single card from an ordinary pack—to be presently described—is a delicate manœuver, and while the expert may nearly always succeed there are some illusions which depend upon the drawer taking a card similar in suit and number to one already prepared elsewhere for the purpose of the trick. In this case it is absolutely necessary that the card drawn should be the right one, and even the most accomplished performer sometimes resorts to another expedient to be certain of forcing a simple card. This is absolutely insured by a "forcing pack," *i. e.*, a pack in which all the cards are alike. In this case the drawer may do his utmost to exercise a free choice but will be certain to draw the desired card. Where more than one card is to be drawn as in the preparation for the well known trick of the "rising cards" the pack may consist, instead of similar cards throughout, of groups of two or more particular cards; thus, one-third may be queen of hearts, one-third aces of diamonds, and the remaining third seven of clubs. It is only necessary to offer different portions of the pack to different choosers to insure one of each sort being chosen. Where more than three cards are required, a tapering pack is offered to various individuals in the audience; as they are gathered up

[1] I quote from Binet's work on suggestion, not having seen the original work.

they are placed with a regular pack which has been substituted and are thus readily distinguishable.

The descriptions of the method for forcing a regular card are much the same in all works on conjuring from Houdin's time to the present. When one wishes to force a card the first precaution is never to lose sight of the card in order not to risk confounding it with another. The card to be chosen is first put beneath the pack and kept there while the pretence of shuffling the cards is made; the operator then makes the pass to bring the card to the middle of the pack, in which position it is easier to force it. These preparations take but an instant, indeed they are made while explaining to the audience in a lively manner that a complicated experiment is to be given which requires that a card be chosen by some one in the audience. The conjurer with light step descends the run-down and approaches the nearest spectator, requesting him to take a card from the pack which is presented. A certain vivacity of movement is useful and strikes short the resistance of a recalcitrant spectator; when one is surprised one is more docile. It is best not to present the cards spread out but closed, it is only at the moment when the spectator advances his hand, perhaps a little surprised to see the pack closed, that they are opened for him but are not held immovable, a dozen or more cards from the middle of the pack are made to pass rapidly before the eyes of the spectator and it is in this dozen is found the card to be forced. The spectator, in the rapid succession of cards passing before his eyes, has no time to choose one in particular, but he continues to advance his hand with the thumb and index finger spread to seize some card. The operator follows his hand and notes the direction of his gaze, very gently he advances the pack towards him and puts the very card between his fingers. The person mechanically closes his fingers and seizes the card, believing that he has drawn it by chance from among all those spread out before him. As soon as he closes upon the card, to avoid all contrary determination the pack is gently withdrawn. "The skill employed in this circumstance," says R. Houdin, "can be compared to that used in the passes of fencing. One reads in the eyes of his adversary his determination and, by a turn of the hand, renders himself master of his will." The words pronounced are also of some importance. Before proffering the cards the person is asked to take one from the pack. One avoids using the word choose as raising unnecessarily the suggestion of independence. It is well, also, to seize strongly the cards of the pack except the one to be forced. The spectator without realizing the intention of the operator, feels a resistance and permits himself to seize the forced card which he draws more easily. In spite of all precautions the artist cannot

absolutely control the conditions and the trick sometimes fails; but the practiced conjurer always has a new line of conduct ready to follow.

Binet[1] has studied the different processes involved in this feat and makes the following points: 1. "The pack is first presented closed to hinder the spectator from making his choice before the operator has put the cards under his eyes; if he could see the cards spread out while two meters away, he could fix his eyes on one and hold it by malice or timidity. To avoid this result the pack is opened only when it is before the spectator, and he has already extended his hand with the intention of seizing a card. 2. If only a dozen to twenty cards in the middle of the pack are made to pass before the spectator, it is to indicate to him that it is in these cards that he ought to make his choice. They are the only ones presented to him, and it is altogether natural that he should not think of taking those which the operator keeps under his hand. The choice is then not upon 32 or 52 cards of the pack, but is limited to a smaller number. 3. The cards are made to pass in an unceasing movement, first, because this manœuver makes the spectator believe that several cards are put at his disposal, and, finally, because then the eyes of the spectator cannot be fixed upon any one. 'The play consists, on the whole, of rendering particularly difficult the choice of other cards, and rendering easy, on the contrary, the choice of the card forced. The conjurer acts on the instinct that when we are on the point of choosing between several possible acts, none of which possess any particular interest, it is the facility of execution which determines our choice. Our thought follows, very naturally, the line of least resistance.'"

The same author compares with this feat that of "the card thought of," which depends on the same principle. The only difference is that the choice is mental instead of being with the hand. The subject is asked to fix his choice secretly upon one card of the pack which are made to pass rapidly before his eyes while spread out. The artifice of the feat consists in making the cards pass so rapidly that the person cannot see them distinctly, save one, and that one is the determined card, which, by opening the pack a trifle more at this point, is made more easily visible. The eyes leap upon this, and the chances are greatly in favor of the person choosing it. The reason being that "to choose a card by chance it is necessary to have the idea in some form. When he sees distinctly only one card of the pack he is given an idea which facilitates the work to be done. If he wishes to name a different card he must commence by ridding his mind of the idea of the former card and then call

[1] Binet: *op. cit.*, p. 107.

up the idea of another card. This would be a longer and more complicated process, but as their exists, it is supposed, no special motive for taking one card rather than another, the thought will follow the line of least resistance, and he will name the card first seen."

This law of economy is in evidence in all the activities of body and of mind. The biological advantage accruing from it in the formation of useful habits is too well known to require statement. A hierarchy of habits, as Bryan[1] has shown, is a condition of progress in the individual and in the race, for, while progress comes at the cost of effort, and while it is impossible if one yield to the tendency to do the easy, the habitual thing, the secret of it lies in making difficult actions automatic that they may be used as the alphabets of more complex actions. However, the majority of people remain for the most part subject to the law of inertia, and in the strife between the routine and the critical spirit the triumph of the former is assured. This law, shown to exist in forcing tricks, appears throughout the whole range of conjuring illusions. To most people, when off their guard, it is not an impossibility that an orange should change into rice or a ball pass invisibly from one cone to another first shown to be empty. It is only when one comes to oneself sufficiently to bring into use his general belief in the uniformity of nature that one escapes from the belief in the miraculous. While one is only attending with the lower sensory centers the feeling of enchantment is paramount. When anything occurs to arouse a suggestion of incongruity this feeling is dissipated. This is a reason why a conjurer should never reveal how a trick is done, or expose the methods of rivals, such actions give the audience an unnecessary clue, arouses suspicions which they would never have thought of, and which will remain to spoil the effect of any subsequent trick worked by a similar process, and, in general, it will tend to diminish the prestige of the performer by showing by what shallow artifices an illusion may be produced.

V.

Sociological and Pedagogical Observations.

Interest in Conjuring Deceptions. The spectators experience an undoubted pleasure in witnessing the feats and illusions of the conjurer. Evidence of this is seen in the continued existence of this kind of entertainment, and especially in the crowds attending on them. An analysis of the causes for this pleasure is difficult. Some of the elements lie far back in an inextrica-

[1] Bryan, W. L., and Harter, N.: Studies on the Telegraphic Language, Psych. Rev., Vol. VI, No. 4.

ble tangle, others are more on the surface. Of these last may be mentioned the general pleasure in witnessing action of any kind—in the satisfaction of the craving for spectacles which was pandered to by ancient civilizations who found the conditions of popular contentment to lie in providing "shows and bread."

Another element is certainly the puzzle interest. Divested of all their dramatic and magical features, these feats yet remain as puzzles and as such are capable of motivating an intellectual curiosity, for the "puzzle[1] activity is an expression of an intellectual play instinct" with the affective accompaniment of all play. The biological uses of this activity are obvious. It leads to inquiry into the unknown; to a necessary investigation of the environment and the increase of power which comes from the acquisition of knowledge and an enlarged horizon. Were the performances under discussion, however, merely puzzles, public interest in them would be short-lived. The deep lying popular interest reflected in modern magical performances must be referred back to the remote past. It is undoubtedly, in part, at least, an inherited anlage, an interest derived from the awe or fear that supernatural ideas have always inspired. In every age man has manifested "vague unconscious fears of the unknown, of darkness, of mysterious powers, witchcraft, sorcery, magic,[2] etc." The tendency to animism which peoples the world with spirits is a force representative of the strongest of human interests. Through long ages the workings of the laws of nature have been to the ignorant an inexplicable enchantment. Relying on the instinct for the marvellous—the interest in things wonderful—the priests of primitive ages, as we have found, were always able to indulge an innate tendency to deception and to maintain their claims to superiority. The facts of sense presented under the authority of religion were received with a veneration due to the miraculous element and worshipped because enshrouded in a sacred obscurity. With the advancement of science the serious aspect of this religious sentiment has declined, but the interest in everything claiming a supernatural character still exists in a modified form whether ghosts, spiritualism, hypnotism, or magic. In this, as in other aspects of our psychic life, we see that man, though he has sloughed off so largely the traits of his ancestors to assume the livery of culture, has not cut loose from the habits of the past. In the activities of his complex social life there is seen the same play of forces working towards the same biological end. We are all children at conjuring shows. We like it because we then

[1] Lindley: "A Study of Puzzles," *Am. Jour. Psych.*, Vol. VIII, p. 456.

[2] Ribot: "The Psychology of the Emotions," p. 210.

get away temporarily from the shackling logic of our lives. The crust of nature is thin, and we easily slump through into a state, perhaps analogous to the old conditions when we took things for granted; when everything was wonderful that we did not understand, and no one but the priest could understand it. We cut loose from our higher centers and let the nerve impulses run through the easiest channels, as indicated in the last chapter, and in this passivity there is pleasure.

The tendency to believe mentioned above, has a legal interest because of its bearing on the value of evidence. That witnesses in courts of justice may be prejudiced and corrupted by different forms of suggestion is well-known. In the light also of what has been said regarding the ease with which the senses are illuded, it is seen that the rules for the admission of evidence are none too rigid, and that the judicial officer, on whom their administration depends, has need of special training in the laws of mental action.

Indeed a knowledge of psychology has practical value in all departments of life, as showing how perfectly simple in reality are some apparently wonderful things. It has been a great agent in chasing away superstition. It has given a clearer knowledge of the relation of mind and body, and shown how bodily functions are modified by mental suggestions, and has thus taken away the supernatural character of a host of acts of healing, of faith cures, the accounts of which are still given out in certain quarters as miracles.

The general human credulity which has made the profession of the conjurer possible is also responsible for a large class of adepts which afflict society. These charlatans play upon the same weakness of mind as the conjurer. They stand ready to adapt themselves to every opportunity; to take advantage of the uppermost popular apperception. During the summer of 1899, when the public interest in the kissing bug[1] visitation was at its height, "in Washington, professional beggars seized the opportunity, and went around from door to door with bandaged faces and hands complaining that they were poor men and had been thrown out of work by the result of kissing bug stings." There are always hairbrained financial schemes being exploited to relieve the credulous of their means. The South Sea Bubble, Credit Mobilier, Jernigan Sea Water Co., and other schemes promising five hundred and twenty per cent. are historical cases. It is the victims of these swindles who maintain the horde of fortune tellers and other parasites of society of a similar kind, never reflecting that if the power of these pretended seers was

[1] Howard, L. O.: "Spider Bites and Kissing Bugs," Pop. Sci Mo., Nov. 18, '99, p. 34.

real, they would be found actively engaged on the stock market rather than up dingy stairways.

A class of sleight of hand performers obnoxious to law abiding communities are the pickpockets. They understand quite as well as their brethren of the stage, the mechanism of attention. In every large crowd brought together to witness an exciting spectacle, they are present to ply their vocation. Trusting to the general absorption they work with little fear of detection. Their manner of procedure in actively diverting attention, however, is somewhat different. They step on the toes of their victim, or jostle him while deftly abstracting his watch.

Pedagogical Observations. Several points of interest to education appearing from the study of conjuring may be reviewed.

1. The interest of young children in conjuring illusions offers itself as a fruitful topic for investigation, both as showing the time it arises and its nature. From experiments performed before children, and from observations of them at their first conjuring shows, it appears probable that interest in the performances as transcending ordinary human acts, does not arise in many cases till the age of five or six years or even later. The young child sees nothing impossible in such feats as a coin changing to two in the hand, etc. He has no intelligent curiosity because he has as yet no ideas of causality. He is like the savage of whom Spencer[1] says that he "cannot make the distinction between natural and unnatural because he has not the conception of causal relations in the abstract;" "there being for him no established general truths."

2. The lives of the conjurers show that continued success in their calling depends upon their ability to constantly produce new marvels. To keep pace with the popular hunger for the new thing, they are always adapting the latest scientific discoveries to their purposes. Old tricks are also often revived in new form for the astonishment of the rising generation. This inclination to conform to the shifting popular interest is shown in the performance itself. A conjuring rule is "in arranging the programme make each trick more surprising than the last." Obedience to this rule is compelled by the law of diminishing intensity of feeling. It is a necessary consequence of this law, as Hoffding[2] shows, that repetition must weaken feeling, enthusiasm be succeeded by indifference, and if carried far enough, by absolute loathing. This law demands greater emphasis in education. In those exercises in the child's train-

[1] Spencer, Herbert: "Data of Sociology," Vol. I, p. 97.
[2] Hoffding: Outlines of Psych., p. 277.

ing where drill still seems necessary, great delicacy is required in his guidance, for to maintain the pupil's interest the stimulation must increase. Adapting for the teacher the conjuring rule just given, each illustration must be made more interesting than the last, but with this safeguard, that it be not more stimulating than is necessary to carry the interest; for overstimulation leaves the pupil indifferent, and in the condition of the child who did n't want his toys, but wanted to want them.

3. The education of the conjurer presents something of value for popular education. The motor training which comes from the practice of juggling very greatly increases the efficiency of the individual, and might well be a part of the programme of instruction. Only one who has acquired some degree of skill can appreciate the superior power of the conjurer.

4. It is recognized as the correct procedure in pedagogy to cause the pupil to bring the proper subjective element to the interpretation of the objective facts presented, and problems are deemed fit according as they find some correspondence among the ideas he already possesses. The conjurer reverses this process as has been shown, seeking constantly by the aid of all his arts to lead the audience to the employment of the wrong apperceptive material; and the spectator impelled along these lines, and finding no solution, is in proper condition to be mystified by the denouement. The problem he presents is insoluble to most people; that is the aim of the magician. His reputation depends upon his giving his audience nuts which they cannot crack. In inclining their minds to take the direction of greatest complexity, he contravenes the proper theory of education. In this, however, he does not sacrifice the interest of the spectators as would be the case were the same method applied to the education of youth.

The deep interest in the feats of the conjurer inspires one to ask whether it may not profitably lend itself to pedagogical purposes. An inspection of the skeloton tricks given in the chapter on classification reveals the wide use the artist makes of the various scientific principles, and suggests their value as illustrative material in the teaching of the sciences. Perhaps most can be claimed for the pedagogy of magic in the realm of physics. Nearly every important principle in this branch of knowledge is exemplified in one or more of the tricks given. In the demonstration of the principles of electricity, mechanics, hydrostatics, optics, and acoustics, the feats given may have an exceedingly important function. Certainly a knowledge of their use in the field of magic would give the subject added interest.

5. The responsiveness of a crowd was noticed by Houdin. He says in his memoirs on this point, "How many times since, have I tried this imitative faculty on the part of the public. If you are anxious, ill disposed or vexed, or should your face bear the stamp of any annoying impression, your audience straightway imitating the contraction of your features begin to frown, grow serious, and ill-disposed to be favorable to you. If, however, you appear on the stage with a cheerful face, the most sombre brow is unwrinkled, and every one seems to say to the artist, how do you do, old fellow? Your face pleases me, I only want an opportunity to applaud you." Substitute teacher in the above, and we have a situation found in every schoolroom. Every teacher is in some sort a conjurer. She fills the artist's place, and by every look, tone, or gesture is a source of suggestion. What ideas, what actions shall result, rest largely with her, hence the need of teachers of culture who may fill a large place in the plastic life of their pupils as gracious inspirers to better things. The child by the very law of its development must act on suggestion, must respond to his environment. If his teachers, his parents, or the community do not present the proper suggestions or do not offer them in a skillful manner, he will react to wrong ones.

Bibliographical Notice.

The references to authorities cited are given at the bottom of the page. In addition, general use has been made of the excellent bibliographies of magic given in Hopkins's "Magic and Stage Illusions," etc., Burlingame's "Tricks of Magic," Vol. III, and Lehmann's "Aberglaube und Zauberei."

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THE FALLACY OF EXTREME IDEALISM.

By Stephen Sheldon Colvin, Ph. D.

The attempt to get at reality is as ancient as the history of thought itself. From the days when the Ionian philosophers sought in their conception of the ἀρχή an indestructible and final element down to the latest hypothesis of our own time concerning atoms and energy, the human mind has been seeking something ultimate, something removed from the law of relativity and change; it has been trying to escape from the πόλεμος of Heraclitus. This quest after reality began in Greek thought as a purely physical concept, and although its later history has been more closely connected with metaphysical speculation, it has by no means lost its interest for empirical science. As long as the ideal of research is truth, it cannot be a matter of indifference what the reality is. In fact it is impossible to ignore the problem completely, and some sort of ultimate being must be held to exist; if not explicitly, then implicitly. The far reaching importance of such a conception the history of philosophy has not infrequently shown. The Hegelian notion of reality, which dominated the thinking and to an extent the practice of Europe from the beginning of the present century to the Revolution of 1848; that of Schopenhauer, which later took its place, are examples of this fact. Schopenhauer, in particular, by one brilliant intuition revealed to the world a path to reality which science has since been glad to tread. Even if it were admitted for the moment that the problem were of no importance for empirical science, it must be conceded that it has the greatest meaning for the ethical and religious life. Its importance, however, by no means makes it necessary that every investigation should be prefaced by a consideration of this question, or that it is desirable that sciences should attempt accurately to define its conception of reality on all occasions. This would be a hinderance to progress in certain lines of investigation without doubt; all that is asserted here is that the inquiry has a legitimate function which even the most thorough-going empiricist would do well to consider.

When we look at the question of what the Being of the universe is from the standpoint of the history of this problem we are at once confronted with a difficulty arising partly from the inexact use of philosophic terms. The various views, may,

however, be in a loose way divided into two opposing lines of thought, namely, Idealism and Realism. These terms, however, have not always had the same meaning attached to them, and in some instances both may be applied to the same system of thought with equal propriety. For example, the great idealist of antiquity, Plato, is from one standpoint a pronounced realist, while on the other hand the realism of Herbart has idealism at its basis Locke and Hume both accept the conception of naïve realism that there is a world of things outside the mind which impress themselves upon the thinking substance and reproduce their exact counterpart in the world within. Yet these realistic conceptions pass over into their opposite. Berkeley demolishes the conception of corporeal substance, and Hume goes still further. Both the material substance and the *res cogitantes* have vanished under his skeptical treatment. The use of the word idea, by this school, too, has had much to do with unsettling the terminology.

Despite these difficulties, however, it seems possible to divide the idealistic attempts to reach ultimate reality into *three classes*, namely: (1) those which have gone out from *psychological;* (2) those which have gone out from *logical;* and finally (3) those which have gone out from *ethical and religious* considerations. Realism, on the other hand, may perhaps best be considered under the heads of the so-called common sense view of reality, and critical realism which has at its basis both psychological and logical considerations. Idealism, again, may be considered from two separate standpoints according as it places the ultimate reality in a thinking process merely, or grounds it in a being or beings which possess rationality as their most essential characteristic. The first type is the legitimate outcome of the psychological and logical (the epistemological) standpoints; the second may be called ontological idealism or, better, spiritualism, and is the direct antithesis of materialism. This view of reality, however, may be called realism equally as well as idealism. Pure idealism on the other hand may lead to practical materialism, as illustrated in the schools of later Greek philosophy, while realism may possess strong idealistic tendencies, in striking contrast to materialism, especially of the practical sort.

In order to do away with the obscurity which is sure to arise in any discussion of idealism and realism in the present state of philosophic terminology, I venture upon a definition of these two opposing systems of thought which I am aware is in a measure arbitrary and certainly unhistoric, but which seems to have the merit of more or less sharply defining the limits of the two conceptions, and which, further, is the standpoint from

which the discussion in the present paper aims to develop itself. From this standpoint *idealism* may be *defined as the assertion that the ideational process is the ultimate and determining reality*, that all other reality is secondary to this, and in the last analysis reduces itself to idea. In other words, and more simply, that *without idea there is nothing*. Realism, on the other hand, maintains that with every ideational process there is a beyond, a something to which the idea as far as it is true refers, that is not to be reduced to the idea, that would exist even if the particular idea should vanish, and that is therefore to an extent independent of the idea. Care should be taken, however, in interpreting the word independent. It cannot be taken to mean that the idea and the *other* to which the idea refers are absolutely unrelated. It means simply that the idea is not in the ordinary sense of the word the cause of the other, and that the existence of the object is not absolutely determined by the existence of the *idea* as such. It may be true that the idea as far as it is a psychical fact is so related to the other to which the idea refers that any change in the idea may be attended by a change in the object, but the same may be true of the relation between any two objects in nature. All nature may be so intimately connected that the change in one part may necessitate a change in another. Certain it is that the idea and the other to which it refers in so far as it is a true idea, are closely related, and realism would say that this relation is one of *causality*. It is therefore unjust to realism to say that it separates the idea and its object in such a way that they become independent reals and therefore can never be brought together by any means whatever. Certain realistic systems may have attempted to do this, but even the most radical have left an implicit relation which they have assumed as valid, even while denying that such a relation exists.

The idealistic standpoint of treating the world appears early in the history of philosophy, although the psychological argument against realism belongs more essentially to modern thought. The favorite method of attacking the common-sense view of reality was originally logical rather than psychological. Heraclitus, Parmenides and Empedocles all declare that only through thinking can truth be reached. The senses give illusion. They denied what could not be *rationally* explained, a course which their successors likewise followed. The Pythagoreans made mathematical thought the measure of reality, and turned their attention to the heavens, the only realm of order and perfection. In all these philosophers may be seen the tendency to over-emphasize the rational faculty—to leave experience full of contradictions in order to satisfy the demands of logic. Zeno, however, was the first philoso-

pher who turned logical laws, pure and simple, upon external reality in order to destroy it, and he used a device which has often been repeated since his day—the employment of the law of the excluded middle to demolish the standpoint of his opponents. Zeno belonged to the Eliatic school and wished to show the unity and absolute simplicity of being. He therefore set about to prove that plurality and motion were impossibilities. This method of attacking reality is perhaps best exemplified to-day by the logical subtleties of Mr. Bradley, who, after proving to the reader's satisfaction that nothing which he has placed his faith on as certainly real can have any existence, then proceeds to build up a notion of reality which opens itself to the same criticism as that which he has so relentlessly destroyed, thus leaving the seeker after truth with nothing in the universe but the barren logical law of the excluded middle. The fallacy underlying this particular form of idealism will be touched upon at greater length in a later part of this paper.

Refuters like Zeno were the Sophists. Protagoras, one of the most celebrated of this school, left logical treatises entitled, Καταβάλλοντες and Ἀντιλογίαι. With the merely sophistical side of the Sophistic doctrine, with their verbal quibbles, their catch-questions and their ambiguities of speech, we have no concern here. This was not, however, their entire stock in trade. They did really offer serious problems to be considered, and their method of procedure was on the idealistic assumption that that which does not agree with the laws of formal reason must of necessity be unreal. Finally, Gorgias, how far in jest and how far in earnest it would be difficult to say, in his book Περὶ Φυσεως οὐ περὶ τοῦερι του μὴ ὄντος shows that there can be nothing real except the individual ideas of the moment. Protagoras declares the individual state of consciousness the measure of all things. The subjectivity of the sense perceptions gives no absolute knowledge. Protagoras's reasoning is based to a considerable extent upon psychological considerations as well as upon logical arguments. His position is essentially idealistic in so far as he assumes that we are limited to our ideas as far as knowledge is concerned. There are many points of resemblance between his standpoint and that of Locke and Hume. In so far as he assumes a thinking subject and an independent object his standpoint is realistic, but this assumption leads to an idealistic position very similar to that reached by Locke and Hume.

The tendency of thought started by Socrates and brought into systematic unity by Plato and Aristotle may be regarded, as has already been said, as possessing both idealistic and realistic features. Socrates is a realist in so far as he places over

against the individualistic standpoint of the Sophist's the eternal and abiding nature of the good. Socrates is an idealist, however, in so far as he makes the moral consciousness the basis of his epistemological concept.

Plato's starting point is essentially idealistic. He assumes with Protagoras that perception is relative, and places thought above it. He then takes up Socrates's standpoint and develops a system of ethical rationalism. Plato, however, is a realist in his final notion of the ideas. Ideas have a true existence in the immaterial world. They are the abiding being in the change of phenomena.

Aristotle in his philosophy accepts the Socratic-Platonic doctrine of ideas; and further his conception of reality as the self-determined individual is an out and out idealistic assumption. As far as Aristotle regards species as essences, however, he approaches the realistic position of Plato.

Did space permit, further examples of the mingling of realistic and idealistic conceptions in Greek philosophy might be cited. Enough, however, has been said to show that there is in all the systems of antiquity no sharp division between the two schools of thought. Greek philosophy was always fundamentally realistic in its assumption of the thinking subject and the external world, which impresses itself on the mind as the stamp does on the wax. On the other hand, it always showed a tendency toward idealism, as has already been said, by exalting logic above the intuition of the senses. This standpoint may be better criticised in discussing certain features of modern philosophy, where the idealistic and realistic motives are in sharper contrast.

One of the most characteristic differences between modern and ancient thought is the attempt by the former to do away with all preconceptions, to start with axiomatic truth and to develop all from this standpoint. The *cogito ergo sum* of Descartes and the geometrical methodology of Spinoza are of course classic examples of this attempt. If Descartes had been true to his ideal he would never have got beyond the idealistic assumption contained in his celebrated dictum and would have ended where some of his successors did, in solipsism; but, while he pretended to do away with all pre-suppositions, he was in many respects as thorough-going a dogmatist as the scholastics against whom he rebelled. Those, too, who took up his standard did no better, and the epistemological problem, started with modern philosophy, found no real solution, not even in the great Kant. The line of thought begun by Locke and culminating in the successors of Kant is, perhaps, the most fruitful for a study of the modern epistemological problem, and may therefore be considered at some length.

When Locke laid down the dictum that as a preparation for all metaphysical discussions, the question of the validity and limits of human knowledge must be considered, he mapped out the future of epistemology. Linking his theory of knowledge, too, with empirical psychology, he laid the basis for an idealistic development which later ended in solipsism. And here may be observed the innate contradiction of that idealism which is based on psychological arguments. In order that it may be effective it must assume at the outset, just as Locke's philosophy did, the actual existence of an external world as well as a world of ideas—in other words, it must be naïvely realistic. In accepting this standpoint, however, Locke is finally forced by his reasoning to deny his presuppositions. He ends with the assumption that the knowledge of the self is intuitive while the knowledge of all else is inadequate—in fact, substances are unknowable. If Locke had been thoroughly consistent in placing inner experience to the fore, he must have ended where Berkeley did, in doing away with all corporeal substance and in abandoning his distinction between primary and secondary qualities of matter—recognizing in the last analysis that they are all mental states, and as such, not the substance of the supposed object of these mental states. Once admit the thesis of Locke as to the relation of the outer and the inner world and the conclusion is certain. All *esse* is *percipi*. Hume's deductions from Locke's premise must be taken also as perfectly legitimate. According to the standpoint of Hume, all the certainty we have is that of inner phenomena. Mathematics is a perfectly demonstrable science, but only because it relates merely to inner experience. Such notions as substance and causality, however, have no objective validity. Hume reaches the extreme standpoint of the psychological epistemologist. The mind is but a bundle of perceptions. This standpoint, it may be noted, goes beyond solipsism itself, for while the latter view leaves the thinker, Hume's standpoint has nothing but the perceptions themselves to constitute reality. This result is so characteristic of an idealism which starts from psychological considerations that we may stop for a moment to point out more definitely in what the error of the argument consists.

In the case of the philosophy of Locke and Hume the point of departure is the assumption of the common-sense view of reality as valid. There are two distinct entities, mind and matter. Matter acts upon mind, but the impress that it makes is a psychological fact, and as such is distinct from the external matter. What we really know, then, are states of mind and not the thing beyond that causes these states. But cause, thing, substance, are also ideal terms. How can they

be said to have an *external* validity. All we can know are the ideas and their relations. But if this is true, then we have no right to say that there is anything external to these ideas, at least anything we can know. The ideas, then, are the only realities that we can speak about. Here is the conclusion in complete contradiction to the assumption made at the beginning.

Suppose, however, it is objected that it is not necessary to assume an external world at the outset in order to take the psychological standpoint for the development of an idealistic position. Let us begin with the idea and argue that all our psychological processes reveal nothing beyond themselves, and therefore that we can assume nothing external to the *idea*. This is, however, an equally untenable position. If carried out consistently it must mean that we cannot know anything but the present psychological moment. All our past ideas no longer exist as such—they are the other, to which the present idea refers. They are as truly external as the objective world itself. All comparison vanishes on such an assumption; all reasoning is gone. Without the other, the beyond, to which the idea refers, the very distinction between truth and falsehood vanishes. All ethical values too are lost. "Eat, drink, and be merry, for to-morrow we die." Here is where absolute and consistent idealism goes over into a practical materialism.

But suppose we look at the idea as a psychological fact merely, and not in its reference to an object of knowledge. Can we then consistently maintain that we need not transcend this psychological immanence? No, for here we are confronted with a difficulty as great as the one previously pointed out. Ideas as psychological facts are continually changing, and these changes cannot be explained from their ideal content alone. Therefore one of two assumptions is necessary. Either the ideas are discrete, unrelated facts, and we have an atomistic universe without connection and mutual relation, or there is a basis outside of the mere ideas themselves for the change in the ideas. If either of these two alternatives is accepted, the standpoint of idealism pure and simple must be abandoned. Certainly no idealist of to-day would hold to a world of independent ideas, but he would be equally abandoning his position to seek for a union of the ideas outside of their ideational content.

"But," says the advocate of the idealistic thesis, "although my view may involve difficulties, how are you as a realist to escape from the apparently self-evident proposition that you can know only ideas?" We should not for a moment underestimate the real difficulty that this question raises, yet an answer to the problem involved does not seem altogether im-

possible. The idealist in raising this query seems to be laboring under the fiction of the thing-in-itself, a conception which in various forms has played an important role in epistemology, but which was developed to its true significance in the theory of knowledge by Kant in his attempt to answer the skeptical arguments of David Hume in the "Inquiry Concerning Human Understanding," and in his Essays, which latter seem to have been the source of Kant's knowledge concerning the Scotch philosopher. Kant's well known answer (or rather an attempt at an answer) to Hume's inquiry was that space, time, causality, etc., have a validity as the forms in which the human mind as such grasps the external world and that these forms have an immanent but not a transcendent value. The forms, however, without content cannot perform their function, and experience even in a purely phenomenal world would be impossible. So Kant was forced to posit the thing-in-itself, the unknown and unknowable X, the irreducible surd of knowledge. But at this point Kant departs from his idealistic basis, and asserts the existence of a real apart from knowledge, though without justification in view of his premises and in direct contradiction to his epistemological pre-suppositions. Now what was Kant's so-called thing-in-itself? It was that which was at the basis of knowledge as far as it was real, and as such in direct relation to the ideas as giving it validity. Indeed, the thing-in-itself was related to the idea by the very tie which Kant had assumed had only an immanent and no transcendent application, namely, the law of causality, which Hume had reduced to a mere convention. Thus we see that Kant's alleged thing-in-itself is nothing of the sort, but is really a thing-in-relation. Kant could not avoid this inconsistency in his theory of knowledge after having once assumed his fundamental position, for a real thing-in-itself is unthinkable, it is a nothing, and never could have existed as we attach meaning to the term existence. That which does not enter into relation in some way, does not have the power of acting upon something else, may perhaps be the Eliatic Being, but it has no true reality, and cannot be grasped by thought. *Mere esse is nothing.*

To conclude this part of the discussion. The idealist in making the assumption that we can know nothing but ideas, and hence can never get beyond a psychological basis, is assuming that if there is a beyond it is a thing-in-itself, as are the ideas of which he assumes we have an immediate knowledge. Cast aside the fiction of the unthinkable thing-in-itself, and we have no real difficulty in saying that we can know reality through ideas, even if that reality is not in itself primarily idea. We know a thing as it affects the thinking substance, and this thing is not a mere *esse*, certainly not a

mere *percipi*. Its reality consists in its activity. *It is what it does*, and we know it as an agent. Could we know its complete activity, we should know its complete being. This brief review of the standpoint of psychological idealism may be sufficient to indicate the fallacy on which its suppositions rest, and the contradictions into which it falls when strictly interpreted.

We may now for the moment consider the second method of the idealist in attacking the realist's position, namely, that of the use of the logical law of contradiction, which, as has already been said, was a favorite device of Greek philosophy, and which finds an acute and able expounder in modern philosophy in Mr. Bradley. Mr. Bradley's method of establishing his idealistic position is well illustrated in one of his recent works, "Appearance and Reality." In his discussion the logician takes our ordinary common-sense views of the world, and by applying the law of the excluded middle tries to show that they are self contradictory and hence must be unreal. Then after having reduced the external world to mere appearance, he proceeds to set up his own notion of reality,—a stream of thought ending in the Absolute, a goal which is seemingly the mere negation of thinking. After reading this treatise we are expected to believe that space and time are pure delusions, that substance and causality are mere fictions, good enough, perhaps, for our grandfathers, but clearly unnecessary for up-to-date mental furniture. But after all, Mr. Bradley's arguments are not wholly satisfactory. The law of the excluded middle is a very good one in logic if used with care, but it has very serious limitations. Take, for example, Zeno's classic argument against motion. An object must either move where it is or where it is not. But either case seems a logical impossibility, hence motion is a theoretic contradiction. As a matter of fact, a third possibility is left. A thing can move from where it is to where it is not, and in reality motion is a fact. So, too, with Kant's famous antinomies, the law of the excluded middle becomes inoperative, as he has shown in his analysis. Did space permit, it does not seem impossible to show that Mr. Bradley's arguments are of the type spoken of above; but granted for the time that his logic is perfect, his psychology is bad. If time is not a reality, then our psychical life is not real; if there is no such thing as space or substance, our whole thinking is hopeless, for we cannot get on without employing these notions, so deeply are they interwoven in our experience. Finally, if causality fails, then is our whole reasoning vain. May we not legitimately question the right of logic over experience? Has the law of contradiction a greater value than that of sufficient reason?

There may be difficulties and antinomies in our way of look-

ing at reality, but that does not warrant the logician in discarding the most fundamental of all our intuitions. And he cannot dispense with these ways of looking at reality, even if they could be put aside without falling into contradiction. They are at the very basis of language itself. We may think we have got rid of them, but they are sure to creep into our way of looking at things even if we are the most pronounced of idealists. Further, Mr. Bradley's logic, when turned against his own idealistic position, will demolish it as easily as he has demolished that of the realist. Are ideas substance; have they causal relations; if not, how are we to think of them? I take it that Mr. Bradley's logical idealism is typical of all attempts to demolish external reality by bringing the law of contradiction to bear upon the assumptions of naïve realism, and that if the assumptions on which his epistemology is founded are seen to be false, all idealism of this sort will fall into distrust.

In concluding this part of the discussion, just a word may be said about the idealistic position as founded upon ethical and religious arguments, and here we must turn to Kant in the latter part of his Critique of the Pure Reason and in his Critique of the Practical Reason. Although there is much doubt as to just how far Kant intended to go in his practical philosophy, there is not a little to show that he never regarded the moral and religious implicates as reaching to the transcendent. God, freedom and immortality are necessary assumptions for the individual life, but may not be ultimate realities. Although Kant's arguments have been used to establish an idealism of an absolute sort since his time, they are not convincing, and should be treated as postulates of faith, rather than as demonstrable certainties.

One of the latest and most able exponents of the idealistic position is Prof. Josiah Royce, and a consideration of idealism may well take account of his position, especially as outlined in his latest work, "The World and the Individual." Prof. Royce is too careful a thinker to fall into the extreme contradictions to which the types of idealism mentioned above are liable. He sees the force of realism and attempts to answer its demands to an extent while still holding to idealism. Notwithstanding this his arguments when held strictly to account make use of the psychological and logical motives just discussed, though often in a form so disguised that it would be difficult to detect them in their purity. One point of view which seems to dominate his whole discussion may be considered as partly logical and partly psychological. It is essentially treating the other to which the idea refers as a purely subjective fact and insisting that it is ideal, since it must be defined in ideal terms. Beside the psychological motive of reducing all to immanent

experience, there is here the thought, apparently, that the mere logical category of identity (A=A) cannot be transcended.

In his latest book he discusses four phases of the conception of being, under the heads of Realism, Mysticism, Critical Rationalism and Idealism as he understands and interprets the term. The first three views of the world he analyzes and then rejects as either wholly or partially inadequate, and then builds up his own conception of reality, after having removed the other systems of thought from his path. Of realism, as Prof. Royce interprets it, he has little good to say, except in its demand for individual being. Its great fault, he says, is in attempting to define the reality of the world as something entirely independent of our ideas. "This solution," Prof. Royce says, "must be rejected on the ground that with an independent being our ideas could simply have nothing to do." Further, "ideas, too, are realities, and if realism is true they are therefore in their whole being as independent of their supposed realistic objects as the latter are of ideas. If, then, it makes no difference to the supposed external beings whether the ideas are or are not, it can make no difference to the ideas whether the independent external beings are or are not. The idea can then say to the independent object in a realistic world, 'What care I for you? You are independent of me but so am I of you. No purpose of mine would be unfulfilled if you simply vanished, so long as I then still remain what I am. And I could, by definition, remain in my whole being unaltered by your disappearance.'" Royce asserts that the genuine essence of "realism consists in defining any being as real precisely in so far as in essence it is wholly independent of ideas that while other than itself refers to it." He declares that the realist makes an absolute separation, and of course such a separation can then be bridged over only by an inconsistency in thought and reasoning, Hence, the whole realistic position becomes invalid.

At this point we will not stop to discuss the truth or falsity of this assumption, but pass on to the second view of being according to Royce, that of mysticism and which he thinks comes nearer the truth than realism, but still falls far short of the goal. "Mysticism seeks being as an immediate ineffable fact," but does it at the expense of quenching all ideas and that makes them all alike illusory: "The absolute, then, although the knower, must be in truth unconscious." It is simply by denial of the finite that mysticism reaches the infinite. Yet mysticism, according to Royce, has one great advantage over realism, which is essentially dogmatic, in demanding that you accept as real independent beings, but mysticism, on the contrary, is from the outset reflective and is

founded on an appeal to experience. "It points out to you, first, that if any object is real for you, it is you alone who can find within yourself the determining motive that leads you to call this object real," and this, Royce holds, is one of the essential features of idealism as well. "Realism actually asserts hopeless contradiction, while mysticism is essentially self-conscious and states its own defects." But we must abandon both realism and mysticism, for both are abstractions. "Finite consciousness seeks a meaning that it does not now find present, but this meaning can neither be a merely independent being or a merely immediate Datum."

There is another conception of being which critical rationalism attempts to set forth, and that is,—"To be real means to be valid, to be true, to be in essence the standard of ideas." Prof. Royce proceeds to consider this third conception of reality, subscribing to it, but pronouncing it inadequate as to its extent. There are many such realities, says Prof. Royce, which no one considers as real in the sense that Democritus's atoms are real. "These objects find their whole *esse* in their value as giving warrant and validity to the thoughts that refer to them," and hence have an ideal existence. Such realities are the present price of the market, the social status of any member of the community, an international treaty or the constitution of a State. "There are also the familiar realities in mathematics, as for example, ideal entities of the type called functions. All such beings have their validity alone in relation to ideas, and can only exist as objects of actual or possible knowledge." They belong to the realm of Kant's Mögliche Erfahrung. This third conception, says Royce, "is not open to the attacks to which realism lays itself liable of being dogmatic and uncritical. Unlike mysticism, too, it recognizes that to lose sight of the value and positive meaning of finite ideas is to render naught the very objects which the ideas seek." "This view of reality has often appeared in the history of philosophy as a critical attack upon realism. This motive appeared in Berkeley and also in Kant, who layed down the thesis, 'Nur in der Erfahrung ist Wahrheit'—Experience furnishes the only ground for truth."

The third conception of being must be accepted as far as it goes, says Royce. But is it adequate? Can the realm of validity remain merely a realm of validity? This leads to a discussion of what truth really is. Two different views of truth are often advanced. "One asserts that truth has to do with that about which we judge. In the second place truth has been defined as a correspondence between our ideas and their objects." Taking the first definition we find that truth is expressed by means of the judgment, which may either be universal in its form or partic-

ular. The universal form of judgment simply undertakes, as does the hypothetical, to 'exclude from valid reality certain classes of objects. It is based on the principle, *Omnis Determinatio est Negatio.*' Universal judgments state a general abstract fact, they assert what being cannot be, but do not tell us what it is. The particular judgment, on the other hand, is merely empirical and does not get at the final truth. "Both kinds of judgments are indeterminate and cannot be taken as expressing reality in its final form."

Let us consider the other conception of truth, namely, that it consists in the correspondence between the idea and its object. First, arises the question as to what is the object of an idea, and further, what is the relation of correspondence. A correspondence between an idea and its object does not mean, says Royce, that the idea must of necessity be the copy of the object. You cannot look from without as a spectator and view object and idea and say that they do or do not correspond. Every finite idea must be judged from a teleological standpoint, and no external criterion of truth can be applied. The idea must decide its own meaning. Volition must be at its basis.

Now, how can an idea have an object at all to which to correspond? It has been held that the object is the cause of the idea, but how, asks Royce, can this be with ideas of future objects such as my own death? "Further, how about the whole realm of past being which has gone beyond recall. What is the irrevocable past now doing to our ideas that the fact of its irrevocable absence should, as a cause, now be viewed as moulding our ideas?" "It is hopeless to persist in the hypothesis that the object of an idea is, as such, the cause of the idea."

Royce concludes that no such separation between idea and object can be made as critical rationalism would assert and modifies this way of looking at the being of the world by his own conception of idealism. "Idea and object are related because the object does not transcend the idea and always in the last analysis is ideal." "The idea seeks its own, it can be judged by nothing but what it intends." "The object meant by the idea is judged as an object because it is willed to be such, and the will in question is the will that the idea embodies." "Even seemingly passive objects that appear to be forced on us can be understood as objects only when the ideas embody the will to mean them as such objects." When I have an idea of the world, my idea is a will, and the will of my idea is simply my own will itself determinately embodied. Being, finally, is the full and adequate expression of what our finite ideas mean and seek and is grounded in an individual life of experience. This is the aim of Royce's Idealism, a brief outline of which I have attempted to give.

Royce's concept may from this brief statement seem to lay him open to the charge of subjective idealism and to do away with the possibility of distinguishing between truth and error. He himself has foreseen this difficulty and seeks to avoid it. What reply can be made to the objection that common-sense teaches that experiences and experience alone (no matter what your will or its conscious embodiment may be) determines what is and what is not? Royce replies that he perfectly assents to the proposition that experience is the last test of truth. He insists with Kant on the proposition, Nur in der Erfahrung ist die Wahrheit. But what is experience? Experience for Royce has a purely ideal definition in the last analysis, and so by appealing to experience you do not get rid of idealism.

But it is a well known fact that ideas themselves conflict—that they offer from time to time no thorough-going consistency. What then is the criterion of truth and of error, and what is ultimate reality?

"Reality," says Royce, "as opposed to illusion, means simply an actual or possible content of experience, not in so far as this experience is supposed to be transient and fleeting, but in so far as it is conceived to be something inclusive and organized, the fulfillment of a system of ideas." But we have no such experience as an actual fact in this world. Hence Royce argues with convincing conclusiveness to the existence of an Absolute Experience, to God. Once grant him his premises and the conclusion must follow. There must be somewhere, somehow a reality—and if that reality is *ideal*, then, since there is no perfect fulfillment of the ideal in the finite, there must be an infinite to realize such a fulfillment.

But now the question arises—are we forced to admit Royce's assumption that the real is the ideal pure and simple. The present discussion would maintain that no such necessity exists. Royce claims in the first place that all other conceptions of reality except his are proved to be either self-contradictory or only partially embody his view of the world. The first view of the world that he criticises adversely, that of realism, he asserts is not to be considered because it separates entirely the idea and its object. This statement may be true when applied to certain systems of realism, but it is not necessarily true. The general conception of realism, that the idea and its object have either a direct or indirect causal connection furnishes a most intimate union, one better comprehended, despite all logical attempts to destroy the notion, than any system of connection which Royce is able to set forth. So far, then, Royce has not succeeded in his critical attack upon realism, and the possibility of a realistic view remains.

Further, how does Royce build up his own idealistic position?

For the most part he succeeds by defining in idealistic terms all conceptions that in any way conflict with his system. Take for example the use which he makes of the term experience. Thought and experience are for him inseparably joined—but how? Experience is allowed to have no separate existence. He asserts that 'percept and concept, idea and sensation, the rational and the sensory, are connected by the thinking subject,' and to this proposition realism may well assent until it finds that Royce means that in the connection all is transferred into thought, beyond which there can be nothing. Here, it seems, is the real point of Royce's whole argument—and here he offers no valid proof for his assertion beyond the familiar one that we are ultimately confined to ourselves—a standpoint of the solipsist. I do not mean to assert that Royce himself makes this statement in so many words, but it is quite possible to reduce his arguments to this basis. Further, take his argument in which he attempts to show that certain ideas have their reality purely on the subjective side, as for example, the credit of a bank or the constitution of a nation. The reply may be made that the idea does not constitute their reality any more than the idea of a horse is responsible for its existence. These realities are psychical in their character, and as such cause the ideas which refer to them. Their *esse* is not wholly in the percipi—our psychical life is by no means exhausted by the idea. Further, mathematical and physical concepts are not determined as real or unreal according to their agreement with other concepts. Does energy really exist? Does or does not n-dimensional space exist? Only in so far as they belong to the structure of the universe,—that is, only in so far as they are able to enter into the causal series, and in some way occasion or determine phenomena.

Finally, Royce has departed from pure idealism when he puts into his notion of reality, the teleological and the will element. The will goes beyond ideas and is not determined by them but itself determines them. It was no mere accident or caprice which led Royce to put this conception of will into reality which sums itself up in the Absolute—in God. For God can be thought of not as limited in *ideas* and therefore all ideas, if reality is merely ideal, must ultimately be true. No, replies Royce. Only those are true which he himself wills. He is self determining. But the will,—what is that? Can that be ideally explained and reduced to idea? If so, then it is a mere term and nothing more. It might have been dispensed with entirely. No, Royce finds the necessity of getting beyond the idea, and here in the last analysis his system has a realistic basis. He has not succeeded in establishing his idealistic position.

In view of this discussion what view can we take of reality? We certainly cannot view the universe from the point of extreme realism, which posits the thing-in-itself, an unthinkable and useless nothing. Neither, on the other hand, are ideas, as such, capable of building a universe. The true ideas themselves must be related, and some set aside as false. But in this way finite experience never can reveal to us the truth, and we have no certain warrant for positing an absolute experience. What, then, is true; what is false? The only thing that we can attach truth to is that which is causally active. The thing is as it acts, and truth consists in defining its activity. We get at truth through the transcendent law of causality, which says that every change in the psychical as well as the physical world has a cause, that every new idea as well as every change in the direction and intensity of motion has its condition, its occasion. Royce speaks with contempt of the notion of brute force, but it is this same brute force that biology tells us has developed the human species to its present evolutionary level. Force, energy, activity, will (call it by what term you may deem best), expressing itself on the ideational side in the law of causality, is the most fundamental fact of our experience. Logical subtleties and epistemological tangles may confuse us, but cannot induce even the solipsist to ignore its practical validity. Being is that which acts, and ultimate reality is a system of ordered activity, in which every part is related to every other part, and consequently in which the thing-in-itself is without meaning and reality.

VISUAL AND TACTUO-MUSCULAR ESTIMATION OF LENGTH.

By Edgar James Swift,

State Normal School, Stevens Point, Wis.

These experiments were undertaken to determine the comparative accuracy of the senses of sight and touch aided by the muscular sense, in estimating unknown lengths.

The tests were made upon sixteen young men, students in the Stevens Point Normal School, ranging in age from 16 to 36 years.

The plan of the investigation included visual and tactuo-muscular estimation of length, (1) when each piece varied from the preceding one by half an inch, the other dimensions remaining the same for each series, though all dimensions varied with the different series; and (2) when the length and other dimensions varied irregularly.

Thirty-five pieces of planed wood were the objects judged.

The tactual series were taken first. The subject was seated in a chair and blindfolded, before the pieces which he was to estimate were brought into the laboratory. Each piece was handed to him in the order of gradually increasing length, as indicated in the figures at the top of each chart. He was allowed as much time for his decision as he desired.

The visual series immediately followed the tactuo-muscular. The subject stood in front of a bench on which the pieces were laid, one at a time, in the same order as before. He was allowed to look at each piece so long as he desired before deciding, but could not touch them.

Chart I represents graphically the first series. The line of no error is marked 0, and the other figures at the left, above and below 0 indicate the amount of over and under estimation, according as they are plus or minus. One square represents a variation of ½ inch.

The figures at the top of the charts give the real length of the pieces under examination. The width of these pieces was 4⅞ inches and the thickness ⅜ of an inch.

The greatest average visual error is seen to be an underestimation of about 1-5 of an inch and the last a little less than ⅛ of an inch. The line is remarkably regular.

The tactuo-muscular error, an underestimation as before, is always greater.

CHART I

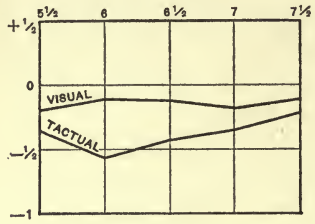


CHART II

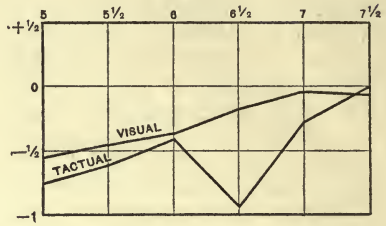


CHART III

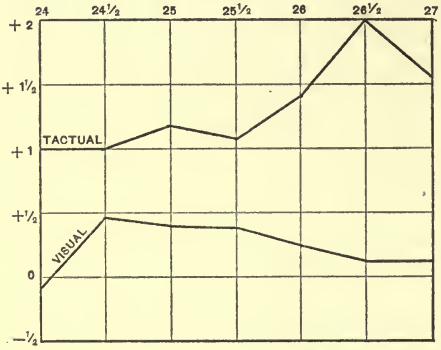


CHART IV

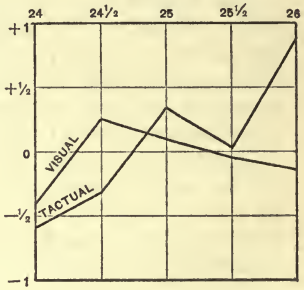
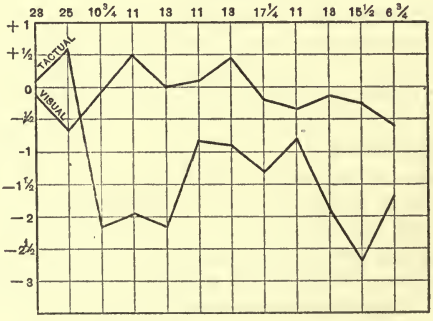


CHART V



The width of the pieces estimated in Chart II was 2⅛ inches and the thickness ¾ of an inch.

The least visual error is $-\frac{1}{16}$ and the greatest is $-\frac{9}{16}$ of an inch. The least tactuo-muscular error is o and the greatest is $-\frac{15}{16}$ of an inch. The visual line, beginning with quite an error, steadily approaches the line of no error. The tactual line is more erratic.

The length represented in Chart III differed greatly from the preceding as shown at the top of the chart. Their width was 3⅜ inches and their thickness ¾ of an inch.

The lines show an overestimation in both cases, the tactuo-muscular greatly exceeding the visual. The greatest visual error is not quite ½ inch while the greatest tactuo-muscular is 2 inches.

The pieces estimated in Chart IV were 1½ inches wide and ⅜ of an inch thick.

Both lines are quite irregular. The visual begins with its greatest variation, an underestimation of ⅜ of an inch, and jumps at once to an overestimation of ¼ inch. As in all other series the tactuo-muscular error is the greater.

In the preceding estimates the pieces increased in length regularly by one-half inch. In order to learn to what extent this regularity aided the subjects in coming to their decision another test was made with pieces that varied irregularly in all dimensions. The result is given in Chart V.

It will be noticed that while the visual line is more irregular than when the pieces varied regularly, still the greatest error is only a little more than the greatest visual error in Chart II. The tactuo-muscular line shows great variation and great irregularity.

A comparison of the charts shows :

1. That the sense of sight is much more accurate in estimating length than the sense of touch aided by the muscular sense.

2. In judging short pieces, the tendency is to under-estimate both by sight and touch.

3. The visual memory, at least for a short time, is more accurate than the tactuo-muscular. The subjects were able to carry the lengths gotten through the sense of sight better, as shown by the fact that their following estimates were more consistent with the former.

4. The sight judgments are quite regular while the tactuo-muscular make frequent jumps, as though the subject had lost track of his preceding standards of length.

REMARKS ON C. LLOYD MORGAN'S PAPER—"RELATION OF STIMULUS TO SENSATION."[1]

By Max Meyer.

Morgan reports in the above mentioned paper on some interesting experiments, from which he draws the conclusion, that Weber's law does not hold good with visual sensations. This important conclusion is based on the mathematical discussion of the results of his experiments. This mathematical discussion, however, contains several errors, to which I wish to call attention. As soon as these are corrected, there is no argument left in favor of Morgan's conclusion. His experiments, far from contradicting Weber's law, confirm it.

Morgan mixes white with black, red with black, and blue with black in such a manner, that on the rotating disc a smooth and even grading from the center to the periphery results. The distribution of white, red and blue in each case is represented by the curves in Fig. 2 on page 225 of his paper. The author asserts "that neither of these curves is throughout its whole extent logarithmic as it should be, if the Weber-Fechner formula holds good." This, indeed, would be a surprising result, if it were true. He has, however, found another law in his experiments, namely that, "*Equal increments of sensation are produced by increments of excitation in geometrical progression.*" The mathematicians would be interested to know the difference between such a curve and a logarithmic curve. Obviously Morgan does not realize, that just this is the specific property of a *logarithmic* curve, viz.: that the increments of one co-ordinate form a geometrical series, when the increments of the other co-ordinate form an arithmetical one. His assertion that his curves are not logarithmic, is the more wonderful when one notices that his colleague Barrel, in the note on page 228, determines the equation of the curves as

$$x = A\,(10^{by} - 1),$$

which represents just that kind of curve.

In Fig. 4 Morgan compares two curves, a continuous line curve and a broken line curve. The equation of the continuous line curve is given. The equation of the broken line curve Morgan does not give, but states simply that: "The broken line curve

[1] Psychological Review VII, No. 3, pp. 217-233. 1900.

shows *the logarithmic curve*, which passes through the percentages at stages 6 and 14." Yet no curve is determined by two given points. Through two points not only one logarithmic curve can be drawn, but infinitely many. One of them is the continuous curve. What Morgan means by saying that the broken line "is one of the best logarithmic curves which can be found for purposes of comparison," no one can tell. The "best" logarithmic curve is certainly that logarithmic curve, which represents the observed facts, *i. e.*, the continuous line itself.

Yet it is not a merely mathematical misconception which underlies this confusion. On page 232 Morgan says of his black background, that this black "may be regarded as incapable of affording any appreciable amount of positive stimulation to the retina." This is doubtless a serious mistake. There is no reason of presuming, that his "black" can be represented in the equation by the stimulus $x = 0$. On page 226 he says: "In the curves plotted in Fig. 2 the stimuli required to produce the sensation series 5%, 10%, 15%, etc., are *not* in geometrical progression." He does not see, that what he calls stimuli (the figures 3.49, 7.74, 12.94, etc., in Table III) are not the stimuli, but the differences between the stimuli and the constant A. A in the case of "white on black" is equal 15.85 (see note p. 228). If he had added to each of the above figures 15.85, he would have found, that the stimuli are actually in geometrical progression.

In comparing the curves for white, red and blue, Morgan construes these curves in Fig. 2 in such a manner, that comparison is quite impossible. If we wish to compare these three logarithmic curves, the best method is, of course, to represent all of them as parts of one logarithmic curve, the constants of which we choose arbitrarily, in such a manner that the points representing "black" (*i. e.*, Morgan's black, not the absolute black) are identical.

We may choose as constants of an arbitrary logarithmic curve, the equation of which is $x = A\,(10^{by} - 1)$,

$$A = 15.85 \quad , b = 0.008639 \quad .$$

A and b are then identical with A and b for "white on black" in Morgan's paper. This curve is then identical with Morgan's curve for "white on black" in Fig. 2. The ends of the curve represent "black" and "white." We have still to determine, which points of this curve represent "red" and "blue."

We make use, in the case of "red," of the substitutions

$$x = p'\,x', \quad y = g'\,y'.$$
$$\therefore\ p'\,x' = A\,(10^{bg'y'} - 1)$$

The conditions for this being the equation of "red on black" are

$$x'=35, \text{ when } y'=50$$
$$x'=100, \text{ when } y'=100$$
$$\therefore 35\,p'=A\,(10^{50bg'}-1)$$
$$\text{and} \quad 100\,p'=A\,(10^{100bg'}-1)$$
$$\therefore \frac{100}{35}=\frac{A\,(10^{50bg'}-1)(10^{50bg'}+1)}{A\,(10^{50bg'}-1)}$$

$$\frac{100}{35}=10^{50bg'}+1$$

$$50\,bg'=\log\left(\frac{100}{35}-1\right)=\log 13-\log 7$$

$$g'=\frac{1}{50b}\,(\log 13-\log 7)$$
$$g'=0.621$$

Consequently Morgan's "red" must be represented in our curve by $y=100\ g'=62.1$.

The quantity of p' needs not be calculated, since the point of "red" on our curve is already determined by y alone.

For "blue on black" we use the substitutions

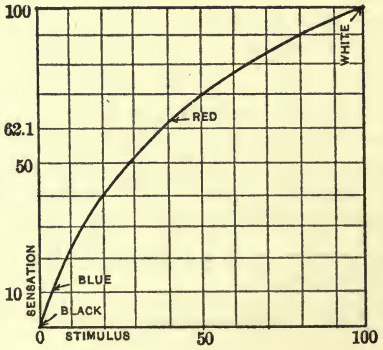
$$x=p''\,x'',\quad y=g''\,y''.$$

Conditions for "blue on black":

$$x''=47.5, \text{ when } y''=50$$
$$x''=100, \text{ when } y''=100$$
$$\therefore 10^{50bg''}=\frac{100}{47.5}-1=\frac{52.5}{47.5}=\frac{21}{19}$$

$$g''=\frac{1}{50b}\,(\log 21-\log 19)$$
$$g''=0.100$$

Consequently Morgan's "blue" must be represented in our curve by $y=100\ g''=10.0$.



The figure shows that the distance from "white" to "black" is considerably greater than from "red" to "black" and the latter again greater than from "blue" to "black." This is easily understood, since Morgan's blue was probably darker than his red and this darker than his white. If we knew that the relative intensities of these three stimuli were (A+100 p″):(A+100 p′):(A+100) we could draw the conclusion, that the judgment in each of the three cases were conditioned simply by the intensities of light, the redness and blueness being of no consequence. However, Morgan makes no statement with respect to the relative intensities of his "white," "red" and "blue."

PITY.

By F. H. Saunders and G. Stanley Hall.

The questionnaire material for this paper was derived from a circular issued by one of us March 28, 1899. As in the case of so many others, the best replies were received from the Trenton Normal School, New Jersey, where Miss Lillie A. Williams has carried the art of getting genuine, intelligent and full data to so high a degree of perfection that this article owes whatever merit it may have very largely to her and her pupils, and to them we wish this paragraph to be a dedication.

Many other returns from other sources, the identity of which has unfortunately been lost have been received, three hundred and twenty-four of which have been carefully worked over for their statistical content by one of us (F. H. S.), who has also looked up the literature and written out an article read at two meetings of the Psychological Seminary of Clark University. All this material he placed at the close of the term in the hands of the other of us (G. S. H.), who has collected several score of additional returns, finished and entirely rewritten the article. More than two-thirds of all represented are females; the average age varies very widely, but is not far from thirty. Many university students here and elsewhere and a few professors and some elderly people have contributed answers, and others have questioned young children in order to gather directly and indirectly their experiences with this sentiment. The matter had to be essentially rearranged so that the order of topics in the questionnaire is lost, and the methods elsewhere described of condensation and elimination have been adhered to. The questionnaire was as follows:

Concrete, definite, and detailed accounts are called for of experiences where pity has been particularly and exceptionally acute, with all circumstances, symptoms, after effects, etc.

I. What story, poem, novel or drama caused intense feelings of pity for the hero, heroine or other character? State briefly the outline and especially the particular features in the tale that appealed to you. The most pathetic thing you ever read or heard.

II. What fact in your own experience, connected with any friend, acquaintance or relative, whether in childish or adult years, caused the pang of pity to be most poignant, seeing people in exquisite pain or distress, suffering, etc.?

III. State with each such case (in I and II above) just how you felt. What physical symptoms, tears, sobbing, sadness, fear? Was

pulse or respiration, appetite, digestion, sleep, or *any other physiological process* affected and how? What did you want to do and what did you do? How long did the effect last; was it noticed by or told to others? Are such experiences sought the second time? What do you do to assuage the pain of such feelings?

IV. Have you ever had these experiences toward animals that were tortured, found dead, killed, cold, hungry or friendless?

V. Describe cases where it was felt for flowers, trees, dolls or inanimate objects, but only if it was strongly felt.

VI. Describe cases where it was felt toward children, infants, the newly born. How did you feel at first to your own just born child?

VII. Cases of this feeling for (a) the poor and famine, (b) the sick and pestilence, (c) soldiers and war, (d) sailors and shipwreck, and others exposed to peculiar hardship and trials, fires, earthquakes, floods, and the war of all against all and natural selection.

VIII. What pictures have excited this sentiment most vividly?

IX. What sounds, cries or noises stand out in your memory as intolerably and maddeningly pathetic?

X. What music has caused it and what were its peculiar features, if any, when thus caused?

XI. What religious experiences have roused your profoundest pity, as a crucified Saviour, and of these scenes what details in them touched you most movingly—the denial, Gethsemane, crown of thorns, vinegar, nails, spears, tomb, burial? Be as explicit and detailed as you care to be here.

I. Pity in Real Life.

In scores of our returns *hunger* in some form was cited as that which had excited the deepest pity. The famine in India was mentioned far most often; Cuba, Ireland, Armenia and Russia follow. Many gave some details of newspaper accounts; some thought the starvation of children worst; others pitied the mental state of those intelligent enough to foreseee the horrible death in store for them and thought that worse than the physical pain; some were led to fear that they themselves might sometime die of hunger or at least lack food.

F., 15. Many beggars come to our door hungry. We are poor and sometimes have to refuse them, but I have often run after them, when they have been turned away, to give them something to eat.

F., 34. I know a poor family of seven. The father is a good and strong man, but cannot find work. They are too proud to accept charity, live on thirty cents a day and the food that I have smuggled in to the children.

F., 17. Saw two shabby little children waiting in the cold on the sidewalk to beg working men for what was left in their dinner pails. I spent everything I had to give them food and went home and cried all night.

M., 21. A young man asked food at our door, which I refused thinking him one of a gang of tramps. A second look showed me he was very hungry. I told him to wait and went after food, but he was gone when I returned with it. I felt cruel and had a sharp pang in my chest, thinking of the poor fellow trudging along all day in the heat.

F., 22. We always distribute chickens and other things on Thanksgiving to some poor families. Once I found a sick widow with four small children in an attic that had really nothing the matter with them but starvation. I kept helping them all I could through the winter.

F., 27. I often visit poor families and sometimes meet those who are actually famishing, whose faces look so pale and pinched that I have to violate the rules of the organization, of which I am a visitor, and run out and bring in food at once.

F., 12. A girl goes to our school in my grade who seems always hungry. She sometimes brings no lunch and I have given her half of mine a great many times.

Two famine pictures—one in Cuba representing scores of people dying and dead, all commingled, lying near a shore; and another depicting a haggard and lean mother on hands and knees just dying, but trying to shelter her infant while vultures hovered and swooped far and near waiting for their prey.

In scores of cases, "the most pathetic experiences" are those caused by hunger. The sunken cheek, the pallid, anæmic complexion, the weakness, inactivity, the anxiety, dumb resignation, the feeble cry of hungry children, the poor quality of the bread, meat, soup, the things that very hungry and starving people in siege, especially in wreck or famine, resort to, adulterations, the bad look and odor of food ladled out in the steerage, the necessity of eating clay, rats and mice, chewing up uncooked corn and rice, and several ultra pathetic songs—"I am starving, mother, starving," "Give me three grains of corn ere I die," a story describing the delirious dreams of famine stricken people of richly laden Thanksgiving tables—all this material, far too abundant to more than refer to, illustrates the strength of this sentiment. On occasions of feasts or unusual table bounty, mankind seems especially disposed to reflect by contrast on the needy, who explore garbage barrels or live on what other people throw away. Possibly the custom, widespread among primitive people of meals in common and punishment by exclusion from the tribal feast, may have so affected our heredity as to give stronger color to this direction of pity. One thing is very plain—that children of the poor, who know what hunger is in their own experience, have far quicker and more effective sympathies in this direction than children who have never felt the pangs of appetite themselves. Most people in civilized life know almost nothing of the very poignant suffering due to lack of food, and adults have little conception of the pain and distress which children feel from hunger. With the young it is a very definite, sharp and localized distress, that may arise to the intensity of agony and anguish; while with adults, as the recorded experiences of the famous fasters show, it is a more diffused and gradually intensified malaise and weakness. At its strongest, it may call out all the forces of the struggle for survival and prompt the best children or adults to theft, petty or great, to forceful robbery and to mutual slaughter and cannibalism. When we reflect that the great majority of animals find their grave in the maw of others and that the struggle for survival has been largely for food, we can under-

stand that it speaks well for the race that pity in this field even for those of an alien race and at a great distance, who suffer from famine, is so effective. The pathos of art rarely resorts to this sentiment. Our returns indicate that this is one of the very earliest directions of pity, and is keenest and most physical in young children, and some pity the hungry acutely who seeem to pity almost nothing else. To feed the hungry is one of the primal works of charity and a virtue with its own benison.

Cold, shelter, and clothing. These three need not here be discriminated; like hunger they stir very strongly the sympathies of the young.

F., 13. The Spartan babies, who were not strong and were left to die in the mountains, used to make me cry so that the teacher would send me from the room.

F., 17. I had to go through a slum section to school, and there I learned how ragged and cold the poor often were. I felt as though I would like to devote my whole life to some kind of relief work and never realized more clearly that more than half the world has no conception how the other half lives.

F., 29. I know an elderly family who have been wealthy, but have lost everything and depend on charity. The privations they endured before they would ask for or consent to receive such were pitiable in the extreme. They live in two bare cold rooms and their clothes are so threadbare and faded and so inadequate to keep them warm in cold weather, that I marvel and go home and cry after seeing them so genteel and yet suffering so much.

F., 28. On an errand I found a family of three living all in one room with a tiny stove, not meant for cooking, sleeping on a floor mattress and one blanket. How they lived, I cannot conceive. Everything was so sad in that room that I wondered they did not die outright, and the woman's weeping broke me down.

F., 27. My most intense pity was for a drunken father, whose wife had died, and whose oldest daughter of twelve had to do everything and look out for the four younger children. The desolation of that room, the squalor and degradation of the whole family, the broken window pane, the big bed in one corner and the heap of rags in another touched my heart as it was never touched before.

F., 14. I read of a baby who was frozen to death in the next street and went around to see. I found a crowd, and the evidences of such intense poverty and suffering, with the little one laid on two chairs and now wrapped up in a new blanket some one had brought, with a cheap coffin back of her, and her mother and an older child weeping, so that I had to go out and sit on the stairs or I should have fainted from the sinking feeling I had.

I once saw a poor woman whose dress was grimy with dirt and grease, the buttons were off and the pins had come out to expose her person in an almost indecent way. She was carrying a big bundle on the street and looked so humiliated, weak and shamefaced, that I felt as though I must follow her and help her. I had a new silver dollar and slipped it into her hand.

F., 42. I saw two children sleeping on a stone doorstep in a wretched street in Chicago one rather cold night in October. The little one was lying on the other's arm and sleeping soundly, while the older one's

eyes rolled with despair. I succeeded in finding shelter for them both, but did not get home until after midnight. I never had such a feeling of having done good in the world for once.

M., 29. Coming up a cross street in New York late at night in a winter thaw, I saw a ragged, drunken elderly woman reel and fall her full length in a puddle of melting snow six inches deep. I think she would have drowned if I had not pulled her out. An officer soon summoned a patrol and told me that she had a good husband and six children, but they lived in filth and cold because everything she could get went to drink. Was weak afterwards, and sick at heart when I got home and thought it over.

Here again many returns show how quickly the sympathies, especially of the young, respond to the deprivation of primitive needs. Some of our returns specify the power that a handful of paper snow on the stage or the simulated piping of the cold wind as, *e. g.*, in the drama of "The Two Orphans," has to open the fountain of tears. One respondent was melted by the glimpse of the shoe of the heroine that had worn through to the snow and was artfully revealed, and a novel I know gives this extraordinary prominence and effect. A little child barefoot or without mittens, or brought in with artificial snow upon its hair or clothes, the pathos of a few falling leaves at a moving moment, the sudden discovery that there is no more coal, that a broken window cannot be mended, that children are lost in the woods or in a city, or even out late, the very sound of the word "homeless" which one of our respondents could never hear without nervous symptoms, the tragedy of a happy home glimpsed through windows by a wanderer who has no place to lay his head, the very suggestion well led up to of exposure to frost, storm, fierce winds, or chinks in a log cabin, of leaks for the rain upon a sick bed, of being turned out of houses by obdurate landlords, of a night in a stable, barn or shed, or the pathos of the leaves that covered children lost in the woods:—these and many such are the causes of all the acute symptomology of pity. Probably as men advanced from warmer to colder regions of the earth, such sources of pathos have been increasingly common, and the readiness with which tears flow in the most tender years of adolescence from such causes attest on the recapitulation theory a vast but submerged racial experience in battling with the elements; and to what a great extent the evolution of the house and of clothing for others has been motivated by compassion for their suffering. These directions of pity are well developed early in life, and in savagery prompt to hospitality often so ceremoniously developed.

Young children pity acutely all who have to be out nights, policemen, firemen, watchmen, who cannot go to bed and must face the darkness and storm. This reflects the fear of the young for the dark. Those who fear high places pity balloonists, steeple climbers; those who fear getting lost pity explorers,

frontier men and lonely travellers; anemophobiacs pity those who are exposed to the wind; astrophobiacs those who are injured or killed by lightning; those who dread animals, solitude or ghosts pity those exposed to them, etc. Valley Forge is prominent in the minds of school children.

Weakness, innocence and helplessness greatly increase the poignancy of pity and this is felt most keenly for young children.

F., 24. I never pitied anything so much as a four months old baby undeveloped, with its little face drawn awry, old looking, asthmatic, pale, anæmic and gasping hard to breathe.

F., 19. I cannot bear to think of young children being punished. If I had my way I would burn all the rods and ferules and make it a crime for any one to inflict any kind of physical suffering on children, unless it was needed medically.

M., 23. A little, dirty, lean, crippled girl, selling papers on Washington Street late one cold evening, touched a new spring in me. I gave her pennies, but she spoke so low I could not hear much that she said, and she haunted me the whole evening.

F., 25. A baby a few days old appeals to me like nothing else in the world. I want to hug, feed and do everything to it, because its helplessness is so unutterably appealing.

M., 28. Had often visited the hospital wards, but went a while ago for the first time to a child's hospital in New York. I was disgusted to find myself blubbering like an idiot, but the things looked so scrawny and pinched and wailed so piteously, and especially so many of them were scarred and doomed to death by syphilis for their parents' sins. This last was the climax of it all.

M., 34. I know a family of nine children, the oldest thirteen. They are all dirty and dwarfed, look ugly and unintelligent as though they were deprived of all the joys that belong to childhood, and were doomed to eke out a wretched coarse life full of hardships. I sometimes think it would be a blessing if they had never been born, all died off young, been exposed or strangled at birth.

F., 23. I pity poor children most Thanksgiving and Christmas.

F., 24. Little children whose father or especially whose mother is dead appeal to me like nothing else in all the world.

F., 18. The strongest pity of my life, was for a newly born infant whose father died before its birth and whose mother was sickly and poor. It looked so innocent and tiny that I had to cry.

F., 27. I cannot bear to see sick children. In my brother's family, the whooping cough nearly drove me into fits. The fact that sick children do not know what is the matter with them and die so quietly and unconsciously and often because of the most culpable neglect on the part of their parents touches me deepest.

F., 23. When children cry in a certain way with pain or hunger or for their mothers, I have to take them up if I can and rock, toss or walk with them to stop their crying. I cannot go away until they are comforted, for it would haunt me.

F., 20. Saw a six months old boy of a friend laid on a bed for a few moments, where he struggled violently to lift himself up. It seems foolish, but his helplessness brought the tears.

F., 24. At an industrial home for orphans, I heard such tales of wretchedness and abuse of children, that I could not help weeping for pity, because they had no one on earth to love them.

M., 52. The first wail of a new born infant seems like a cry of despair, as if all the woe of life was anticipated and expressed in one thin oft repeated note. Pity wrung my heart, too, once on seeing in the Catholic Hospital for children in New York a crèche or richly ribboned cradle, set out in an alcove for the purpose almost on the street, where any mother of an illegitimate child could abandon it and know that it would be cared for and she could go away unknown and hide her shame. The halves of broken coins and charms, mascots with them or devices for identification, are also touching.

F., 40. The thing that makes me maddest with pity is misunderstood children. I have known a few who reminded me of the story of the ugly duckling pecked at and despised by its quacking companions, when it was really a beautiful swan. The child in my case, however, did not, like the bird in the fable, finally develop its song and soar away to a flock of its own species. Talent in one direction often goes along with deficiency in the only lines which narrow parents or friends are competent to see, so that those who deserve the best often get the worst opinions and treatment. The silent child, that cannot express itself because it feels so deeply or has lived in an air of repression and is therefore thought stupid, makes me want to devote myself to a mission for the rescue of such lives.

M., 40. There is one particular cry of a baby which sheds a gloom of pity over the whole world for me. Not the fretting or angry cry, not that of pain or of hunger, each quite distinct, but the cry that expresses to me absolute and utter despair. Only lately have I had to change cars because I could not bear it.

F., 48. I have been a teacher and am now professor in a college. The most pathetic beings I know are stupid students who mean well, work hard, but who I know can never amount to much. Sometimes they plan to become clergymen. I know in my heart that some of them have not the intelligence of many day laborers, but they are so good that they are encouraged to try to live a life far beyond their capacities. I foresee the dull, low level mediocrity, the frequent changes, the discontent, the struggles of wife and children, and the long perspective makes me sick at heart.

M., 30. Saw a little boy walking home with his hand in his father's, crying bitterly. Something made me think that the boy wanted some trifle the father could not afford. Do not know which I pitied most, for the father's honest face bronzed with exposure and hard work showed how sad he must feel to deny his boy.

Pity for children is most often expressed if they are ill fed, and next in order if they are neglected, badly dressed, poor, dirty, crying, ill treated, deformed, cold, barefoot, have drunken or shiftless parents, step-mothers, are blind, deaf or otherwise defective, bullied by those older, taunted with their defects. The cry of infants probably more generally and intensely than anything else in the world, at least it leads by far all other causes in our returns, rouses pity for their weakness and helplessness. The fact that they cannot talk and tell their troubles, their tender skin, the smallness of their bodies so easily permeated by cold, their lack of teeth, their wistful longings for the satisfaction of their own needs which they do not understand, a white baby of a colored mother, poor children gazing in shop windows, those who are constitutionally reticent and

all who are doomed to lack a fair chance in life by taints of heredity excite keenest compassion.

Weakness, sickness, deformity and death have next most frequent mention after deprivation of the primitive needs of food, clothing and shelter. Some think consumption the most pathetic, because of the unquenchable hope of its victims; several specify general paresis because it is absolutely incurable and always kills, but the victims are so elated with their great ideas; hereditary disease most impresses others; the thought that innocent children should be tortured with syphilis is sometimes specified; contagious diseases are specified because they repel help; painful diseases; plagues and pestilence and Defoe provoke others to resolve to become nurses or doctors, while to others the hospital and the sick room are especially intolerable. One young man was haunted for some years in the early teens by the hymn "As when a raging fever burns, we turn from side to side by turns and no relief can gain." He felt the fever in his veins. Sympathy often provokes symptoms, imaginary and sometimes real. The labored breathing, the smell, the hush, the groan, pallor, the strange unlikeness of the patient to his or her former self is what often haunts and chokes the throat or moistens the eye. To some the greatest pathos is when the sick know or are told that they must die, while to others to die under a lying promise of recovery is worst. Young children pity the sick because they cannot play, must take nasty things or stay in bed in the dark and have little conception of pain and none of danger. Those who have had experience in sickness sympathize best with the sick and especially those suffering from the same disease. For others pathos is keenest for the sufferings of friends. The mother who reiterates in an agonized way, "George, speak to me" to her dying son; a child at night crying for its dead mother; a sister clinging to the body of her dead child; the closing of the coffin; the last rites at the grave; the last breath and the dreadful waiting to see if another comes; the death rattle; the dumb spectacle of strangers meeting their friends in bringing home the dead; the very mimicry of cries of pain and distress; the sight of a blind child groping its way; the ugliness and meaningless of the idiot's face; rickety children with distorted features or bodies; the long whoop of whooping cough; the deaf, idiotic, dwarfed, lame children wearing orthopedic apparatus, and many others of the several hundred diseases recognized by pathological standards which often have specialized the pity of individuals:—these alone would more than fill the pages at our disposal, and the second hand experience through novels which flushes a kind of pity is yet more copious.

M., 48. I visited the scene of the Goshen flood a day after it occurred, and saw them digging out a woman whose limb was sticking from a pile of rubbish. Other victims were being rescued, one of whom I had known. Here, of course, there was no fear, but the sense of compassion was perhaps a little relieved by a touch of indignation that we live in a world where such things can occur.

M., 29. I was a reporter in the Franco-German war and the sight of the wounded, maimed and dead in all the attitudes that chance or the last agonies left bodies impressed me strangely. It was not especially hard at the time to witness these scenes, although there was tension and rapid pulse, but the pathos of it came out later, especially at night in thinking it over.

M., 30. I once saw a man killed just ahead of me on the streets of Berlin by a brick which fell from a high building and crushed his skull. Some years later, coming up Broadway late one Sunday night, a drunken man started to go into a dive; he lurched and fell heavily against a sharp iron picket which penetrated his head as he fell and hung his whole weight by it. The pathos in these two cases was very different. I always pity a drunken man and this death in a shameful state on entering a shameful place stirred me all up and for days grew stronger every time I thought of it. The other case was a more sudden shock and in a sense came nearer to me, because I felt that had I walked a trifle faster I should have been the victim. Thus the sense of personal apprehension was strong.

M., 50. I saw a young man hung for the outrage and murder of a young girl. He seemed possessed but nervous and anxious to have it through. Several hundred spectators had been admitted by ticket to the jail and several fainted after the drop fell. Had he resisted or lost strength and been carried, had his crime been less heinous, or had he struggled after the drop, pity would have been greater. As it was, I felt some nausea and a most intense pity for the man. The agitation of the warden in reading the sentence and pressing the spring, the coffin just behind, the glimpse of prisoners at the bars down all the corridors of the jail, the pale faces and often open mouths of the spectators, the tension of absolute silence which lasted half an hour before the doctors said that the pulse had entirely ceased probably increased the nervous strain. My most painful impression was a compression of the chest, and I think my heart almost stopped when the body jerked up after its first fall. The scene haunted me nights later and I had a very vivid picture of how the face looked under the fatal hood which was probably worse than the reality.

M., 28. I saw a bright young German servant fall from a fourth story window in New York. He came into my room to clean the windows and stepped on the outside clinging to the sash. I cautioned him to be careful. He replied fearlessly and stepped out with bravado, throwing down the lower sash and thus knocking off his fingers which clenched the upper one. I sprung and almost caught his feet, but the expression of his face as he went over backward, I shall never forget. He turned over twice and struck a sidewalk breaking both legs above the knee, the bone of one of which was driven several inches into the ground between the bricks. I was first to pick him up and lay him on the billiard table in the basement. The repetition of this narrative twenty years after, for this questionnaire, brings up not only most painful images, but nervous thrills in the spine, neck and chest. It seemed as though I could not have this bright, cheery life thus extinguished in anguish and oblivion.

Some years ago I saw a tree and a mound in the south, where a poor man with a large family, suspected of a crime of which he was after-

wards proven to be innocent, was dragged from his house by a mob, hung to a tree, and when the limb broke riddled with bullets and tumbled into a hole and buried almost before he ceased to breathe. What kind of a world is there where such things are so common?

M., 27. When as a medical student I first attended surgery clinics, I had to stand in the outer, upper circle, so I could rush out to the fresh air if I felt faint, as I often did. The pathos of it was to see the poor sufferers given ether which they sometimes violently resisted; to know that some of them had not consented to an operation at all and had no suspicion beforehand that it was to occur; in other cases they had been told it was slight when life and death hung in the balance. It seemed as though I could never get used to the stertorous breathing, the bloody hands and often face of the operator. I often wanted to do violence to what I thought the hard heartedness of the physician in stopping to explain points to the class and unnecessarily prolonging the narcosis; watched with great tension those whose business it was to maintain the narcotics and watch the heart; and I wished to call out to them when they turned their attention sometimes to the operation. When it was necessary to go deeper or to remove parts or bones that would forever lame or disfigure the patient, I wanted to cry out "don't" or "wait till another time." At one time I thought I could never be a physician at all, because disease and pain were so intolerable, but I have grown used to it and now expect to be a surgeon.

M., 30. Of all diseases general paresis is most pathetic, because the patients are so happy with their great ideas, and yet the disease is absolutely hopeless. I have had two bright students, both of whom had won honors abroad and done and published good work that gave great promise, who slowly began to be uncritical, speculative, developed plans of almost cosmic dimensions for the advancement of their science, in which one spent all the money he had or could borrow, and the other printed absurd memoirs. Both slowly passed from delusions of greatness to those of persecution, which were directed against me—their best friend. The pathos of it all is even worse than that of death, for the mind dies and the body lives on. I think I would have done or given anything in my power to have turned back the inevitable.

M., 27. In the middle of a twenty-six mile stage ride, I was asked to look after a bright ten year old girl and see that she got off the train, which we should reach at noon, at Oswego. She had been placed by friends in a farmer's family where she was not strong enough to do hard work, and they, it appeared, were now returning her to a city where she had relatives, which neither she nor they knew. Bright, affectionate, orphaned, ignorant of even the alphabet, with all that she possessed tied in a red handkerchief, I carried her asleep in my arms and left her with the station agent and a policeman with such directions as I had gathered, a little after midnight one cold stormy night. My heart actually ached for the child, whom I almost took on to Boston with me to adopt, bachelor though I was.

F., 32. I saw an old lady, whom I had known in my childhood and who had been prominent and influential in the town and who was very proud, ride over the hill to the town poorhouse. She was dressed in black with a red tippet, and all she had I suppose was in a yellow wooden trunk in the wagon behind. She was bowed and I could not see her face, but the poignancy of it was long felt.

M., 78. I shall never forget the slave market in New Orleans, where on a business trip I saw for the first time men, women and children pushed forward and knocked down to the highest bidder. The acme

of pity came in the case of young women, whose charms were so coarsely described.

M., 45. I go often among the blind, deaf, idiots and insane. I think of all these classes, I pity most the blind. Idiots do not realize what they lose, the deaf seem happy and active, the insane sometimes probably think they are more sane than their keepers, but the blind seem to know their loss, are generally pale from lack of exercise, inactive and the saddest of all. No wonder that these institutions appeal to charitable people and that Laura Bridgman, Helen Keller, Tommy Stringer and others have been the means of attracting many gifts to the aid of such defectives.

F., 71. I lately visited the museum of torture instruments in the old castle of Nuremberg and looked down the well eight hundred feet into which they cast the mutilated bodies of the Inquisition. The iron virgin was the worst with the great spikes that entered each eye and one for the heart. I could not have endured another half hour with the voluble guide, whose broken English made the whole thing more pathetic.

M., 33. Years ago I read a book describing the arts beggars have used in all times and instructing them how to excite pity by making artificial sores, making themselves temporarily lame, whipping up froth for the mouth, eating powdered glass, how to starve children, teaching them how to whimper and whine, to get hand organs that were low and plaintive, to look blind, lame, etc. This did not excite my pity, but it suggests the strength of the sentiment they appeal to by such trumpery methods and explains how secure and happy the hobo's life may be, because he relies on so strong a sentiment for his living.

M., 29. The very able lady who for very many years has presided over the Associated Charities of Boston, told me that the best method of identifying beggars was by their pathetic story. Each works out a legend, which often becomes very telling by frequent repetitions, of abuse, injustice, disease, misfortune, by which they are often identified under the various disguises they assume.

Poverty, vice and crime have frequent mention. Of the vices drunkenness is most prominent. To see a man reduced to a state of bestiality in which he may do anything obscene or violent or to see him helpless and maudlin, uttering incoherences or saying what in his normal state he would most abhor, and the sufferings of his family, are most prominent. Crime, whether against person or property, excites remarkably little abhorrence, and the criminal arrested, tried, imprisoned and executed, evokes this sentiment with an amazing strength and generality which shows how much stronger it is in the human heart than the sentiment of justice. Unjust imprisonment, especially with suffering, is one of the most pathetogenic incidents of life, and Libby prison of course plays its prominent rolê. The pathos of the gallows, the guillotine and electrocution comes in for its share of this sentiment. Poverty is pitied because it involves so many of the more elementary deprivations; the desperate misery of the very poor as contrasted with the very rich finds strong expression with and occasionally utterance of condemna-

tion and even contempt for the laziness and inefficiency described as its causes.

Many experiences of *fire* and *water* are mentioned. Some pity most those who suddenly lose everthing in a conflagration or describe the painful scenes of men and women smothered or leaping from high buildings; hanging in night-dress from windows; the tortures of being slowly smothered and roasted in the Lloyd steamers; the possibility of waking from trance in a cremation furnace; the horrors of dying people being removed from the flames; fire in railroad wrecks; the life of firemen; explosions in mines; the great fires of Boston, Chicago and London; the sufferings of shipwreck, storms and cold at sea; death from famine and thirst in life-boats; the scenes at the moment when ships go down; wreck of the Portland, the Maine and La Burgoyne are dwelt upon. The smothering effects of drowning are compared with being buried alive. Some small children pity sufferers most for the smoke in their eyes and one has shuddering symptoms at the sound of fire bells and whistles.

Soldiers stand in a peculiar relation to this sentiment. Their hardships, wounds, neglect, death on the battlefield, etc.; their lack of nursing; their liability to be drafted into service or to be suddenly called away from home or sweethearts; their sorrowful partings; their plain food, long marches, heavy burdens; exposure and failure to get letters; their fond thoughts of home and pathetic gazing at photographs; carrying Bibles next their hearts, which perhaps save their lives; disappointments in finding death, absence, alienated affection when they return; their lack of shelter—all these make the soldier's life almost a school of pity by itself, while poetry and romance have evolved a conventional body of sentiments and images often very distinct from reality but of wondrous efficacy. The effect is greatly heightened by the admiration of courage; the intense interest in conflict; the splendor of victory; the dazzling and impressive appearance of uniform, of parades, bands and martial glory. Whatever Tommy Atkins is in himself, he occupies a place in both the pity and the love of susceptible young women which no one else of his rank or station begins to equal.

Several respondents pity most young *women who want to marry* but cannot. Conventiality, which prevents them from making advances, and circumstances over which they have no control condemn those who by nature are best qualified for honorable wifehood and motherhood to an isolation of heart and soul for which the new spheres opening to womanhood and which attract so many are no consolation. Some depict a vast volume of mute and half unconscious wretchedness which sours life not only for the individual but for all those about them to this cause. Several mention as objects of great pity wives,

who for some reason can have no children, and find in sterility a peculiar pathos. Others pity bachelor women, who do not want or are distinctly averse to domestic life, and even urge that such cases are most of all pathetic because of their naïve innocence of the cause of many manifestations of perverted maternity, and because they do not know what real happiness is but are content with its counterfeit. Some urge that the most defeminized of these specimens, who are so prone to diminutives suggesting endearment, who lavish affection upon dolls, cats, poodles, criminals, and take sentimental views of life, are the most pathetic of all objects, and one young woman strenuously prefers for herself some hardships and even abuse from a husband to this. Yet the saints who pity and those who do its tenderest offices everywhere are the sterile workers of humanity, who give to mankind the wealth of affection made for a family circle and illustrate by the transvaluations of love how transformable it is and how many kinetic equivalents it has. These lives seem to have skipped one stage of development and to be farther on toward the disinterested love of the human race and its highest evolution than others. Some pity most the entire sex, present and especially past.

Old age is often mentioned, because the aged cannot play; must sit still or get around or move slowly; lack teeth or stomach for the best kinds of food; are bald, cannot see well or use glasses; are so weak, have such a thin voice, are so irritable cannot bear noise. A boy of twelve saw his father working in the field on his fortieth birthday, take off his hat, and as the sun shone on his bald and gray head thought "poor old man he will soon be dead," and sobbed, as did a girl when her mother first wore a wig. As parents pity the helplessness of early infancy, so children when life is hottest and fastest, most pity the second infancy of extreme age.

Not to multiply instances unduly all *pain* that is appreciated is pitied. Children most pity physical, adults psychic suffering. As if to compensate for much of that distress that is not understood, a vast body of pity is vented on objects and in circumstances where there is no distress but often only enjoyment.

Girls and women far more often specify single cases in detail, and boys and men are prone to generalize. After the dawn of adolesence each sex is more easily affected by the forms of the other than by those of its own gender.

This sentiment is not limited to members of the human family. Pity for *animals* is usually not very vivid unless they are suffering extremely or are connected with the family. Many children think, "what if I were the dog, cat," or other suffering pet in question. In its gesture, sound or eyes, they read an

unutterable yearning for their pity. Even those who hate cats and other animals or feel an especial repulsion often pity them intensely. Some say "exactly as if they were human" and others declare their pity to be of a very different quality. Others have found their sympathy quickened by reading Black Beauty, Our Dumb Animals, or by joining Bands of Mercy. Some even try to rescue drowning flies, get out and walk up hill if the horse has an extra load, etc. Girls often conceive inextinguishable likes and dislikes for men by observing their treatment of animals. The fact that they are dumb often wings the arrow of pity to the core of the heart. The horse, in our returns, is most often pitied because he works so hard, is sometimes abused, overloaded, checked high, pulled at the mouth, left without blanketing, driven too fast, docked, shaved, underfed, made to run up hill, used when lame, blind, thin, made too sweaty, etc. Some pity horses because they were once so free and are now subject to man. Others specify that their pity is because they are so willing to do what they can. Some object to races or pity the losing horse or the aging one. The horse has thus had much to do with widening the range of human sympathy. Dogs are pitied in dog days, when their tails or ears are mutilated, when they are hungry, old, lost or friendless, etc. Some specify particularly pathetic looks in dogs as they gaze in your face in a yearning way. A long list of girl protestations about boys' abuse of cats appears. Many must bring home every lost animal and pity young birds that have fallen from the tree in a storm, are brought in by the cat, especially if not dead, killed for hat feathers, etc.; the Thanksgiving slaughter of turkeys, squirrel hunts, frogs stoned by boys, creatures caught in traps or hunted cause pity. Pity roused by abuse turns readily to anger toward the abuser and many want to inflict the same punishment upon them for revenge or perhaps for justice. Even fish and reptiles are often pitied.

M., 25. Threw a stone at a bird on a telephone wire, hit it, was frightened and ashamed, watched it all day, pitied its mate most intensely and debated whether I should bury it or expose it so the mate could know the worst.

M., 25. When a child, peeped into the ruins of a burned barn where lay five horses suffocated by smoke. Felt a lump in my throat, tried to run away so the children would not see my tears, but fell from weakness.

F., 28. One of two horses, which had grown up and worked together for years, was sold. The other lost its appetite, grew clumsy, weak, looked sad, and roused my compassion to the uttermost.

M., 18. My dog had fits, and every time I could neither look at him nor keep away, felt as though I must do something but could do nothing.

F., 14. We always had plenty of pets and animals, and I felt for and pitied them a great deal, especially those more intelligent, because they wanted to speak and could not. This their appealing eyes

showed. Children who do not have pets, like one of our neighbors, have no pity for animals.

F., 13. I cannot bear to see chickens shut up in a coop or birds in a cage. I have once or twice made great trouble for myself and others by releasing them.

F., 20. Saw a man beat a horse unmercifully with a spade; could not call, speak or leave the window. I seemed to be stifling and was weak for many hours.

F., 10. When my pet cat was lost, I imagined every kind of torture for it for months. At first it hurt me very much, but later I rather liked to imagine new adventures every night.

F., 22. I used to pity animals of all kinds profoundly, but of late years I do not have that choky sensation and quickened heart beat, but only feel depressed.

F., 12. Once I heard of a man who in rage pulled out his horse's tongue. I felt as if the inside of my body had dissolved and the picture of the bleeding mouth of that poor horse was with me for days.

F., 14. Am in a perfect frenzy of pity and rage to see a horse or any dumb beast hurt. I rushed up to a man pounding his horse once and bit him. There is nothing I cannot do.

F., 21. I had a Saint Bernard dog that was long sick. It was four years ago, but I recall very well just how the pity affected me and where it was located in the stomach.

F., 18. Homeless animals, especially if old, touch me most; would like to found a hospital where they could be tenderly cared for.

F., 8. Came round a corner just in time to see a squeaking pig killed. My blood ran cold and I felt as though the knife was stuck into me.

F., 18. At the dog hospital in the University of Pennsylvania, I saw a dog bandaged and panting on the floor of the cage. Was profoundly impressed and wished I could know if it got well.

F., 25. I have the extremest pity for animals that are killed for food. Once for a long time I would not eat their flesh lest I should be guilty of their death. This was after I saw sheep killed once at a slaughter house. To see calves and cattle in the cars going to their death fills me with grief.

F., 38. Words can never express the pathos of vivisection. A man who can cut up the flesh of a live animal, I would not dare to be left alone with. There must be some special punishment for them and I hope some special reward hereafter for their victims.

F., 20. I saw a pretty muffy dog run over by a butcher's cart. It gave me a pang at the heart that made me feel for a long time as though if anything else sudden occurred to me like a fright, I should die of it. I loved the dog and grieved, but the chief feeling was a nervous shock.

M. 26. A pretty black King Charles dog was given to me as a boy, but it proved very troublesome in many ways as we were situated, and a hired man was told to kill it when I was away. I happened to see him strike its head with a hammer holding its body between his legs. I flew at the man and would have done the same thing to him if I could. I do not know whether anger or pity was strongest.

M., 23. I had to shoot a dog that was old and half blind. The boys who owned it could not and I had often played with it, but nerved myself. The gun tore the top of his head off, but as he lay there he looked at me so sweetly and reproachfully that I shall never feel guiltless of Tiger's death to my dying day.

F., 19. We had a playful kitten in the house for a month or two of

whom we had all grown very fond. One day coming down the stairs I stepped on its head not knowing it was near, and it had to be killed. The crunch of its skull under my heel and the horrid thought that I had killed my pet made me sick. I went to bed and sobbed; vomited till the retching seemed to tear my heart.

Plants, and even *inanimate nature*, often serve this sentiment.

F., 18. Always thought flowers had life and breath like human beings and was made nearly mad to see them willfully torn and thrown away. I felt most strongly about pansies because they seemed like little faces.

F.. 23. When a child I saw in the woods where a boy with a hatchet had barked some young hickories. It seemed to me like cutting the skin off a person's body and I could not escape the idea that the tree was suffering, or bleeding, or weeping.

F., 9. My dolly had her kid skin broken and let out the sawdust and a wire stuck through. This seemed dolly's breast bone. I put vaseline on it and bandaged it, but cried all the time.

F., 6. One cold night having forgotten to cover a favorite doll, I went down stairs and wrapped it in a blanket and felt happy. She was restless and tearful before.

F., 11. My doll's teeth were broken and I pitied her intensely, because her jaws must have ached so.

F., 16. Pities flowers and roadside plants when the leaves are covered with dust. I feel as if they could not breathe.

F., 20. When a child imagined flowers and trees lived in families like people with papas and mammas, brothers and sisters, and when flowers were pulled their parents cried just as human parents would, and I often cried myself.

F., 26. When very young a heavy freight train went by. The engine often stopped and puffed hard, and I went sobbing to mother telling her the poor engine had to work so hard. All her explanation could not prevent my pity.

M., 28. When a child I used to pity the moon, when black clouds passed over it. It seemed to me that it had been naughty and was being punished.

M., 30. My little brother rocked too hard on his rocking horse and it fell over and its head was broken. He cried until it was stuck on again, because he thought he would feel it just as we would.

M., 24. There was a bronze statue in the square near our house, and all winter I was much troubled because I thought it suffered from the cold.

F., 15. When a few fine flowers were left over on a bush, I pitied them because I thought they must feel injustice to be left, and I have often gone back and picked them to save their feelings.

F., 19. As a child my mother had me put away the bread every night. In the winter I always rolled each loaf in a cloth, laying another over it and tucking in the edges very carefully, so that it would not feel cold that night.

F., 17. On a roadside, where we often drove, was the figure of a little darky which served as a hitching post. I used to pity the poor little fellow because I thought how tired he must get and how his arm must ache standing there day and night, summer and winter, holding the hitching rein between his fingers. I often remarked upon the subject.

F., 18. The story of the foolish harebell, read to me as a child, always gave me pangs of pity for the poor flower.

In seventy-two cases, pity is expressed for flowers broken, dying, wilting, withered, dusty, neglected, frozen, picked, broken by storms, etc. In fifty cases pity is expressed for trees cut, limbs broken, blossoms mutilated, struck by lightning, blown down, being sawed, cut down in their prime, because they cannot move away. To some chopping down a tree seems like murder; others pity solitary trees fighting the wind or standing bleakly on a hill; others pity pines and firs in winter. Tenderness is repeatedly expressed for pansies as resembling faces. Sixty-two state that they never felt pity for any inanimate or vegetable objects. There is often an uncertainty and indefiniteness respecting the nature of the feeling. Some, who are deeply affected, do not consider it quite accurate to call it pity or say it is not pity in quite a true sense.

Sounds and noises in nature often have great pathetic power.

F., 34. Although it seems a small thing. I think the sound that called forth the greatest pity in my mind was the mew of a little kitten that looked starved to a skeleton, it seemed so human.

F., 21. The chirping of a mother bird for its little one, which had fallen from the nest and could not fly, was especially pathetic.

M., 19. In a country house during a violent snow storm, the bleating of the sheep, and especially of the lambs in their distress, had a a tang about it that was the most pathetic thing I ever heard.

F., 10. When father died, I heard my brother give one long sob that I shall never forget to my dying day.

M., When nine, and often since, the cry of Indians when they behold their dead, which I have heard in a wild west show and later on the plains, was maddeningly pathetic.

F., 8. A mother's cry, when her child caught its eye in a sharp hook, drove me to distraction, made me restless and sleepless, and I made everybody around me unhappy to find out what became of the little one.

F., 11. The cry of horses in a burning barn near my home was the most terrible thing I ever heard.

F., 23. When driving saw a horse run away and break a carriage. The cry of the ladies in it, who were badly wounded, was so mournful I could not get over it.

M., 29. The sound of a consumptive's incessant coughing is the most heart rending sound I know.

F. 28. When father was gunning, some one shot Rover. The dog was brought home and cried piteously till he died. I sobbed myself sick, and although it is years ago can hear that cry yet.

M., 25. As a boy, on very cold nights, the cries and moans of the wind, the crashing of the ice on the pond, the crunching of the wheels on the snow were so mournful that I used to lie awake pitying those who were out and unprotected.

F., 23. The cry of a man in almost the last stages of leprosy, which I heard in the East, imploring aid, seemed to express entreaty, warning, but above all despair that moved my whole being to the core.

F., 23. As a child, if I heard a bagpipe, I would leave my play, run to my room and close my ears, it gave me such an indescribable feeling of sadness.

F., 28. When our factory burned, the watchmen tied back the spring

valve to the whistle, which blew continuously till the flames burned off the cord. This was the most haunting, melancholy sound I ever heard.

M., 26. Describes a boy of six crying "mamma" as his mother's body was being lowered into the grave.

M., 24. My father's call to me and to mother during the years of his illness I can hear now just as I go to sleep. Once he tried to get up, fell and groaned, and it went through me like an electric shock.

M., 40. I saw a child fall from a fourth story window; could stand that, but the gutteral sound the little one made in its helplessness was paralyzing.

M., 26. When a child, the notes of certain wild birds made me feel that they were lonesome and homeless and were crying out for company.

Sounds maddeningly pathetic, as specified in our returns, may be indicated by the following phrases with the number of cases appended:—Wind moaning, 45; sighing, 23; whistling, 6; cry, howl or whine of a dog, 42; in the night, 19; in distress, 4; the peculiar cry of a cat, 14; bleating of lambs, 13; church bells at night or tolling, 20; infants' cry, 30; lowing of a cow for its calf, 4; the moan of sick or insane people, 18; the cry of a loon, 4; muffled beating of a funeral drum, 2; hooting of an owl, 4; the frogs at night, 8; the cry of a robin whose nest is being robbed, 2; creaking of trees and blinds, 5; the phœbe, whippoorwill, turtle dove, katydid; the cry of a father to a horse running away with his daughter; the cry of a drowning person, of those recovering from ether; the whistle of a tug boat out in a storm; the death rattle of a grandfather are also specified.

Just as we are more conscious of stress, inflection and speech—music generally if people are just too far away for us to catch the words, so interjectional cries of all sorts have more power over the emotions than when they are articulated words. As the eye is the sense of the intellect, the ear is the avenue of emotional communication.

II. In Art and Literature.

Pictures have great power to rouse pity. Despite their removal from reality they have great power to evoke real but more remote heat-lighting phenomena. In our returns the Crucifixion is specified 100 times; Gethsemane, 17: Christ carrying the cross, 19; Christ before Pilate, 20; Peter's denial, 22; Mary at the tomb, 11; stripping Christ of his raiment, 6; Mary at the foot of the cross, 14; Last Supper, 15; cross stations, 18; babe in the manger, 6; the crucified Lord in his mother's arms, 6; other pictures with special power of pathos mentioned more than once are Jerusalem on the day of the Crucifixion; Christ or Diana; Daniel in the lions' den; the stag at bay; Abraham about to sacrifice Isaac; the slaughter of the innocents; Mater

Dolorosa; breaking of home ties; Niobe; Ariadne; Laocoön; death of the wolf; burial of Attila; death of Lear; two slavery pictures—one where they were throwing the chained victims overboard to hide their crime before a pursuing frigate overtook them, and another where a brutal man was flogging a beautiful slave woman; wreck of the Hesperus; the dying gladiator; Napoleon coming from Russia; soul wandering from God; the gleaners; Prometheus bound; the Spanish beggars; wreck of the Minataur; the last token; the deluge; execution of Lady Jane Grey; death of Mary Queen of Scots; Marie Antoinette going to her death; the sacrifice of Pocahontas; Dante weeping over Beatrice; forgotten; deserted; can't you forgive me? the Neophyte who had just taken monastic vows he seemed to regret; girl bidding lover going to the wars good-by; children weeping over the grave of their soldier father; girls sentenced to death making a last appeal to the Virgin; old man at fireplace smoking—his only comfort; women watching at seaside for a vessel that came not; sheep huddled before a blinding snow storm; cow alone in the field with snow beating upon her; dying soldier looking at a picture of his wife and children in his watch case; people hanging out of the windows and falling from burning building; destruction of Herculaneum and Pompeii; picture of the Chinese victims of leprosy; old man alone beside dead wife; shepherd lost in the storm; the inundation; water just filling the kennel of a chained dog, which was trying to save children; mother having lost a child became insane and carried a billet of stove wood wrapped in a shawl, children silently pitying her; Bluebeard dragging his wife upstairs by the hair, sword in hand; soldier bringing a letter to wife of dead comrade, he weeps while she reads, most touched by a little girl who did not understand; feeding the hungry; picture of a wife going to the guillotine in the days of the French Commune and saying loudly to her agonized husband, who rushed to save or take her place, "I do not know you," and passing on to death alone because she thought recognition would involve him in the same doom; old negro at table with his head on arms hiding his face, plate and empty chair near, with a flower by the plate; old monkey with sick young one in its arms, suggesting the affection of animals.

Nearly two hundred novels are mentioned more than once and the scene in them, which touched the deepest chord of pity which the respondent had ever felt. These it is difficult to characterize. *Uncle Tom's Cabin* is mentioned nearly three times as often as any other work as moving pity. Next follow in order *Evangeline*, *East Lynne*, *Enoch Arden*, *The Old Homestead*, *Quo Vadis*, *Hiawatha*, *Old Curiosity Shop*, *Romeo and Juliet*, *Romona*, *The Elsie Books*, *Man without a Country*,

Mill on the Floss, *Ben Hur*, *Thelma*, *Lorna Doone*, *Oliver Twist*, *David Copperfield*, *Little Women*, *Merchant of Venice*, *The Babes in the Wood*, *Jane Eyre*, Defoe's *Plague of London*, *Army Nurses*, *Ancient Mariner*, *Flight of the Tartar Tribe*, *Donald and Dorothy*, *Ten Nights in a Bar-room*, *Birds' Christmas Carol*. The most pathetic scene in *Uncle Tom's Cabin* are his own death and next that of Eva. The age at which this book is most often read and also most affective is from twelve to fifteen. The passage where Eva has her curls cut, calling in the negroes, and giving them one each to remember her by when she is dead; the whipping of Tom, his sale and separation from his family, his parting from Eva, the sale of Eliza's child, the grief of Aunt Chloe, Eva's good-by to Topsy and to her father.

The following are a few of the most touching incidents in the above stories. The misery of Ada Graham with her stepmother; the pity for Ben Hur's mother and sister in their wanderings, imprisonment, leprosy, unjust accusations; Ginger's telling his troubles to Black Beauty; story of a windlass drawbridge, where the keeper's child in trying to turn it aright in time for an approaching train, fell into the water and was drowning, the father's frantic strain between love and duty, finally righting the bridge and leaping in saving his child; the parting of Beulah and her younger sister at the orphan asylum when the latter is taken away by a strange lady; boy carried out to sea by the tide in a boat; Burns' story of the poor little mouse; death of Steerforth; Copperfield leaving home; Faust pleading with the devil who comes to claim his promised soul; the pathos of Dreyfus, particularly when his sword is publicly taken and broken, his epaulettes and buttons torn off before his comrades; friendless little Nello alone in the world but for a faithful dog, when his last hope from a picture is unsuccessful; Elsie always trying to make her father love her older spoiled cousin, Emma, while the latter causes him to misjudge and maltreat his own child; the Acadians driven from home, families parting in the churchyard, the farewell glance at their burning village; Evangeline searching for her lover and finding him on his death bed, the hospital scene, etc.; the imprisonment of Marguerite and her praying at the shrine of the Madonna; Pip's cruel treatment of Joe Gargery who had done so much for him; the desertion of Amy Holden by her own husband; Rebecca in the hands of Front de Beouf, the treatment also of old Isaac; for Mr. Rochester with his insane wife and Jane's treatment by her aunt; Halifax thrown out into the world to beg; the inevitable separation of Lucille from her true love; a hero sentenced never to see his country again or even to hear of it while reading to his companions and stumbling

over the lines "Breathes there a man, etc.;" and who dies exhorting his companions to loyalty; little Nell's devotion to her grandfather and most of all her death; Uncle Josh searching for his son, finding him drunk, giving alms to a tramp really his son to whom he tells of his long search, with the quartette "The old oaken bucket" generally inserted here; the hunger of poor Oliver who could not get enough to eat, and the death of Nancy Sykes; Ramona, the Indian girl, engaged to Alessandro, he shot and she condemned to sorrow the rest of her life; Little Red Riding Hood so deceived by the wolf; poor Rip's treatment by his wife as if he were a child, when he is so kind to everybody; the lonely life of Savanarola and the injustice he suffered; the hero who is guillotined in place of another, because the latter can do more good in the world; the tragic end of the cripple Aseneth singing in the flames of Pemberton Mill, Lawrence, for joy from escape from a life too cruel to bear; for Ruth Hope persuaded by an adventurer to marry him, and finding too late that he was vile and a pauper; the passage in "Under the spreading chestnut tree," "It sounds to me like his mother's voice singing in Paradise."

M., 27. Some of the scenes in Dante's Hell, where he places many who did not deserve it, and in the limbo of infants and purgatory of philosophers, and more yet the calvinistic conception of infants suffering in hell forever for the guilt of their progenitors, and pictures of devils torturing the damned, that I have seen in foreign galleries, used to melt me with a pathos which lately is changing into indignation.

F., 44. I never cried harder than over the pathos of poor Rip Van Winkle abused by his wife, so good hearted, yet so besotted, especially when he wakes up from his long sleep and finds everything and everybody that he knew gone.

F., 35. Of all tales in the world, that of "Patient Griselda" is most moving to me. Beautiful, and ideal wife, her husband suspects her love, makes her dress in rags, do menial service, expose herself to insult, lose his love and that of her children one after another, but the sweetness of her submission to it all is what melts the heart and brings the tears.

F., 30. Some things in Walt Whitman's "Leopardi," in James Thomson's "City of Dreadful Night," perhaps the most pathetic of all books, or Burton's anatomy of melancholy, sometimes haunt me with a *Weltschmerz* that is unendurable.

M., 33. Solitary confinement, as in the Zellen-Gefängness of Berlin, seems to me the most pathetic of all punishments. I would far rather die than to be cut off from all human intercourse and be condemned to the society of spiders or a shrub in the yard, like poor Pellico. No book I ever read wrung my heart more than his life.

The scene between the Prince and Hubert, who comes to murder him, in Mr. Tree's revival of King John; the story of Evangeline; of Llewellyn and his dog; of Laoconn in the light of Lessing's description of his suffering and the expression of it as compared with that of Philoctotes; the tale of Jephtha's daughter, innocent, beloved, and wandering two weeks in the mountains to prepare for death, owing to

her father's foolish vow; Scott's Helvellyn, the Wandering Jew seeking everywhere, but in vain, death as a relief from superannuation—these have wrung my heart more than anything else I can now recall.

For many the most pathetic story and scene they have ever read or heard involve death as in the following: where the babes in the wood lie down and die and are covered with leaves by robins; for two in Roache's "Children of the Abbey," where Captain January is asked to give up his little Star and where he later dies; Sheldon's crucifixion of Philip Strong, especially the winter hardships of the child who died after its mother; the story of the poor slum preacher killed by a saloon keeper, whose business he had ruined, as told in "The Dawn of the Gods;" the death of Siegfried, after he had been speared and carried on a bier of twigs toward his home up the hill; Tennyson's "Elaine;" Lady Isabel in "Elsie Dinsmore" watching her son Willie die when he did not know she was his mother, she being in her own husband's house as governess, and seeing him whom she loved wedded to another, later dependent on her cousin who abused her, and dying at last; the unjust persecution of Sir Guy in Younge's "Heir of Redcliffe" and his going to nurse his cousin Philip, knowing that if he takes the disease he will die as he does; the picture of Hiawatha standing by his wife's grave and repeating the passage beginning "Farewell, Minnehaha," and where the "fever and the famine waste the body;" the parting of Hector and Andromache and the former's death; the shooting of Buck and his cousins by the Shephardsons and when Huckleberry Finn pulled them up on the bank and covered their faces with weeds; a negro boy charged with his master's boots and shot by a would-be thief, saying as his master came up just in time to see him die, "Massa, I hab done de bes I could, I have kep de boots;" in a story the crisis of which reads "for a moment more the mute and the leper stood in sight, then without one backward glance upon the unkind human world, turning their faces toward the ridge in the depths of the swamp known as the "lepers' land," they stepped into the jungle, disappeared and were never seen again;" a story recited by an elocutionist of a little girl whose mother refused to kiss her good-night because she had been naughty, whose restlessness later awakened her mother who found her flushed and out of her mind, in her delirium she cried in baby prattle language "pease kiss me, mamma, I'll be dood," and died reiterating this; the story of a young man from the country who had just become a London physician and whose old mother of homely ways planned to give him a surprise visit, she found him with his fiancée, a lady of superior rank, and being ashamed of her represented his mother to all in the household as his old nurse, the next morning she was

gone and after a long search found in a hospital, the fiancée and son kneeling by her side when she died; the story of the young woman who with long delay and great heroism escaped imprisonment in a tower, but had to die nevertheless just after; the tale of Virginius, especially the lines beginning "and now my own dear little girl," the tale of a poor girl selling matches Christmas night, and so absorbed in the splendors seen through a rich man's window that she froze to death on the doorstep; a child dying, the eldest sister brings the father from a saloon with the message of his little one, "I want to kiss papa goodnight;" a little boy who stuck a postage stamp on his forehead, went to the postoffice and asked to be sent to his papa who was in heaven, on the way home he was run over and killed and "papa's little letter was with God;" the story of an early Christian martyr girl, beautiful, and brought up in great luxury, who suffered everything before she died; a hero's wife killed by soldiers for refusing to betray a refugee sheltered in her house; the verse "Nearer the bounds of life where burdens are laid down;"—these may serve as samples of the pathos of death as represented in literature. Sporadic mention only was made of scenes and "motifs" in the Greek, German, and French classical drama.

In response to a request in an English journal for the *most pathetic passages in literature* the following were most emphasized.

"Fear no more the heat of the sun,
Nor the furious winter rages;
Thou, thy worldly task hast done,
Home hast gone and ta'en thy wages."

"The boast of heraldry, the pomp of power,
And all that beauty, all that wealth e'er gave,
Await alike the inevitable hour:—
The paths of glory lead but to the grave."

"But if the master call, run to the ship, forsaking all thy belongings, and looking not behind; and if thou be in old age, do not go far from the ship at any time lest the master call and thou be not ready."

"I was so young, I loved him so, I had
No mother, God forgot me, and I fell."

"And to be wroth with those we love
Doth work like madness in the brain."

"I do love thee so
That I in your sweet thought would be forgot,
If thinking on me then should work you woe."

"It was a childish ignorance, but now has little joy
To know I am further off from heaven than when I was a boy."

"The heartless and intolerable indignity of earth to earth."

Tennyson's Tithonous who vainly prayed God to take back his gift of immortality.

Me only, cruel immortality
Consumes . . . . . .
A white-haired shadow roaming like a dream,
Immortal age beside immortal youth.

An able youth, 1805, perished on Mt. Hellvellyn, three months later his remains were found still guarded by his dog.

"How long didst thou think that his silence was slumber,
When the wind waved his garment how oft didst thou start?"

"We thought her dying when she slept,
And sleeping when she died."

"My long lost beauty hast thou folded quite
Thy wings of morning light."

"The moving finger writes; and, having writ,
Moves on, nor all your piety nor wit
Shall lure it back to cancel half a line,
Nor all your tears wash out a word of it."

"She never told her love,
But let concealment like a worm in the bud
Prey on her wasted cheek."

"My heart is in the coffin there with Cæsar
And I must pause till it come back to me."

"A sorrow's crown of sorrow is remembering happier things."

"Never morning wore
To evening, but some heart did break."

"If the hand that I love lay me low,
There cannot be pain in the blow."

"O, dark, dark, dark, amid the blaze of noon,
Irrevocably dark, total eclipse, without the hope of day."

"So sad, so strange, the days that are no more."

"Deep as first love and wild with all regret,
O, death in life, the days that are no more."

"No more, no more, O never more to me
The freshness of the heart like dew shall fall."

"O, the insufferable eyes of those poor 'might have beens,'
Those fatuous, ineffectual yesterdays."

"Guilt with sweet day's decline
And sad with promise of a different sun."

"Es wär zu schön gewesen.
Es hat nicht sollen sein."

Music. This language of the feelings and the emotions has wondrous power to melt and move all the sentiments cognate with pathos. Sacred music, funeral music, masses for the dead, the minor key, the organ, Moody and Sankey, love or longing for home or country, unsuccessful love, most Hungarian and negro music, music of Memorial Day, are the classes most often specified and in that order. Special pieces are often mentioned and perhaps their effects dwelt upon.

"Almost persuaded," sung low with sweet voices, is mentioned five times; weird and solemn music; "He was rejected;" Mendelssohn's "Consolation;" the songs of colored revivalists because they are "so far above animals and also from us;" "If He shall say well done;" "Home sweet home;" "The baggage coach ahead;" "Break the news to mother;" "Songs without words;" "Nearer to Thee;" "Abide with me;" "Lead kindly light;" "Palms," which seems especially affective with mature people; "Where is my wandering boy;" Rossini's "Stabat mater;" Schubert's "Earl King" and his "Wanderer;" the story and many scenes in Wagner's "Parsifal;" the Lohengrin "Wedding March;" "The vacant chair;" "Tramp, tramp;" "Just before the battle;" "Way down upon the Swanee River;" "Nobody knows de trouble I have seen;" "We'd better bide a wee;" "The old Kentucky home;" "Over the hills to the poorhouse;" "Mount Vernon bells;" "The drunkard's daughter;" "Auld Lang Syne;" "Old black Joe;" "Our battleship the Maine;" "The Whippoorwill;" "Kathleen Mavourneen" (Crouch); "Ben Bolt;" "Days of Yore;" "Mamma's in heaven;" "Dreaming of home;" "Love's golden dream;" "That is love;" Beethoven's "Sonata pathetique;" his "Farewell to Piano;" "Fifth symphony;" "I know that my redeemer liveth;" the whole story of the decline of the gods or the Götterdamerung; the song of two children born and dying the same day, one rich and the other poor; the song "Punchinello;" many of the songs by colored singers; "The holy city;" "In that city;" "Dies irae;" "Gregorian requiem;" "Shall you, shall I;" "Rock of Ages;" "Rest for the weary;" "Far away in that far land;" "When the mists have cleared away;" "Angel voices ever near me;" "At the cross;" "Let the lower lights be burning;" "Some time we will understand;" "The silent land;" "Why not come to Him now;" "Blessed home beyond this land of ours;" "Green hill far away:" these are all specified more than once, and some of them many times, as producing unusually strong effects of pathos and sometimes uncontrollable weeping, anorexia, and faintness. Some shiver as though with the cold; many describe symptoms in the back and spine first, or the hair; others have peculiar tingling sensations; various secretions are stimulated; the respiration and the pulse are affected. For some the timbre of the violin always calls forth this feeling (22 cases); for others the bass but most often the alto voices. Most who undertook this topic were more or less musical and from these returns alone it would seem that the strongest effect is produced neither by music nor by words, but by their judicious combination.

The sentiment of pity has played a rôle of supreme impor-

tance in the spread of *Christianity*. Hundreds of returns specify particularly all the experiences of Passion week. Some are most completely melted at the desertion of Christ by his disciples, others at the betrayal, others by his struggles of soul with himself and with the Father in Gethsemane, but most prominent of all in this galaxy of incitations to pathos is the crucifixion itself and the incidents connected with it. The stations of the cross are often mentioned; Christ commending his mother to the care of the beloved disciple; the prayer, "Father, forgive them, for they know not what they do;" Christ met by his mother on the way to Calvary; taken from the cross and laid upon the bosom of the mother of sorrows; the scene where Christ is stripped of his garments, his flesh bruised and torn from the scourging; the long journey up the hill with the heavy cross and the three falls under its weight; Mary at the foot of the cross seeing the Divine Son suffer and unable to even wipe the blood from his face. The propensity of pity to focus upon some incident in a whole ganglion of events is seen in the group of returns describing the way in which the feelings were effected by the nails of the cross.

F., 32. Never since her conversion has heard the word "nail" without a nervous shudder, the very sound of the word seems cruel.

F., 32. Feels them so intensely that the reader of her returns cannot refrain from thinking that she is well on toward stigmata.

F., 17. Has pressed sharp nails against her own hands, although never deep enough to bring the blood, in order to realize more acutely how it felt.

M., 40. From the age of fifteen all through adolescence often found the place exactly in the centre of his palm where the nails went in. A painful wound near this spot in the hand brought him to Jesus.

F., 21. Used to have very exact ideas what kind of nails were used. They were ten penny nails, blunt at the point, square, and rusty.

F., 34. Often on seeing old nails that looked antique felt a pain in her palms and sometimes in her feet from the strength of her imagination.

M., 26. Pictured the details thus. The nails for the feet were more than twice as large and came out in front of the heel and helped support the weight. They were driven in near to the head in the feet, but in the hands the heads were hammered down into the flesh causing needless pain, and the last blow broke the skin as it rolled over between the hammer and the nail. As a child often shuddered, thinking how the first blows would squeech and creak before they would go through the flesh.

There were twenty-eight who expressed themselves as profoundly affected by nail items.

The spear was decidedly less prominent. Some thought it merciful to end his suffering; others felt that he was too far gone to suffer much from it.

F., 29. Used to place her hand under the lower ribs and thought she could feel the spot where the spear went in.

F., 23. Had a very vivid image of the spear, thought it barbed so that the pain of withdrawing it was even greater than that of thrusting it.

M., 16. Thought it dull and rusty, with a blunt point and with the haft nearly as large as the head. Believed it could not have struck the heart but the stomach as water was mingled with the blood, and thought thus the agony was prolonged.

M., 32. Conceived that the malice with which it was thrust was so great that it penetrated the entire body and was stopped only by the wood of the cross.

M., 32. In the Oberammergau Passion Play, the most pathetic moment to me is when the spear seems to enter the side of Jesus. I had seen the arrangement by which the tinseled point was pushed back by a spring into the haft of the spear, squirting out red ink for blood, but this in no wise affected the poignancy of my sympathy. I saw the play four times and each time felt a lump in my throat and had to wipe my eyes.

Others dwelt upon the sharp thorns pressed into his bleeding head. Some thought these of briers; others of more cruel thorn bushes. A few dwelt upon the pathos of slaking the thirst of a dying man with vinegar and especially given on a dirty sponge. The stripping and scourging were sometimes visualized and dermalized with the greatest vividness. For others the prayer "If it is possible, etc." is the talisman that puts the reader or hearer in the place of the suffering Christ. The order beginning with the most frequent and passing to the most infrequent mentions are the crucifixion itself, next and just half as frequent, scenes in Gethsemane including the betrayal, nails, crown of thorns, scourging, spear, denial, carrying the cross, "If it is possible" and "Why hast thou forsaken me," stripped, vinegar, falling under the cross, meeting his mother on the way, scoffing, the blessed mother receiving her son, kneeling at the foot of the cross, trial before Pilate, loneliness of Jesus, etc.

The circumstances attending the closing scenes of Jesus' life constitute the supremest of all the masterpieces of pathos; nothing in fact or fiction is so consummately calculated to wring the heart. Suffering, both physical and mental, has never been so acute, so graphically and dramatically presented. The incidents succeeded each other in a cumulative way far more effective than in any of the old dramatic unities and their summation seems calculated to bring out every strong and deep tone of which the heart is capable in the field of pity and in all the psychic elements relative thereto. Were it all the creation of some sublime, artistic genius or the slow evolution of the race soul, it would incite hardly less amazement and reverence for the faculties that could create such a masterpiece than we feel for superhuman powers or beings.

Not only this but every effect is intentionally heightened by several fundamental conceptions. First, the innocence and purity of the victim, which always sets off suffering by contrast with the cruelty and vice that inflicts it; secondly, the idea that the suffering was all for mankind in general and for each individual in particular, that every sin and fault of my own drove home the nail or spear, pressed the thorns deeper, added weight to the cross, etc., that to interpret every fault of nature or of purpose as inflicting such pangs upon such a being still is and in the days of the early spread of Christianity among more cruder and more impressionable people was to yet greater extent the mainspring of the power that made the Galileans conquer the world through suffering and sorrow. In many a revival, where all this holy drama has been set in to scene by word painting, really to the cultured more effective than the Oberammergau representions, all this has lived again for the imagination so vividly that men and women have not only groaned and swooned with mental anguish and compunction for their sins, but have suffered with Jesus so acutely as to re-enact the whole story or special parts of it till stigmata appeared from which sometimes real blood has oozed, and visions of opening heaven and sensations of supervening death have been transportingly realistic.

Next to Jesus the sufferings of his mother have excited most compassion and the power of this Catholic conception has never been more manifest than in some of these returns. The stories of many of the fourteen thousand saints, whose biographies the Bolandists have been writing for the past four centuries, appeal chiefly to the sentiment of pity. Most of them are men of transcendent virtue, purity and a kind of naïve consecration—some absorbed in transcendent devotion but tortured to death, a fate which in most cases they welcomed not with stoic imperturbability but with joy and gratitude. The hold of the army of martyrs upon the Christian consciousness, weak as it is to-day, has been most potent and effective in the past.

A great deal of the Old Testament appeals to this sentiment. The story of Joseph, Job, Daniel in the lion's den are intensely pitied by children; the captivity and its incidents; the trial and imprisonment of Paul; Hagar in the wilderness, etc., are very often specified.

The most poignant pity for Jesus, usually felt very keenly in youth, very often wears off by sheer familiarity, and several returns describe how after having passionately longed to do something to mitigate Christ's suffering or to show appreciation for his sacrifice the pathos of it all is mollified by sentiment of admiration, gratitude and reverence. It is often a crisis to conceive what Christ's divinity really means. This sometimes

intensifies pity, but far more often assuages it, because it is felt that a real God cannot really suffer much and that his pain like his death is not fully effective or really real. The deity "motif" in the majority of these returns mitigates the suffering of sympathy, and in some cases is distinctly clung to in the face of intellectual doubt, because it would be so painful to endure the thought of a truly human being without a divine reserve or reservoir of resistance or resiliency undergoing such torture. Jesus' agony at least is here docetically interpreted. Some feel that Jesus' very passivity, while it tends to heighten indignation of his tormentors, intensifies pity. Many returns enlarge upon the blunting effects of familiarity with the story.

M., 26. Used to weep, but now hears or reads the whole story with utter indifference.

F., 23. Hates those who made Christ suffer, but pities more the victims of the fires at Smithfield.

M., 40. No longer feels the sentiment of pity, because it has been so overdone.

F., 19. Cannot recall the old feeling and thinks she is growing hard hearted.

F., 25. Who used to sob and grow very tense with moist eyes and pectoral sensations can still feel for Stephen and for some of the saints, but cannot possibly get up the slightest real feeling of pity for Jesus.

F., 17. Hears the story read in her family Sundays, but just feels a little saddened by it, fears the Holy Spirit is being grieved away and pities herself most keenly because she has wandered from the fold.

F., 22. Used to feel that Jesus was the most pathetic character; now it is Saint Laurence, because his meekness was so admirable and his torture so horrible.

M., 22. Now really pities more a dog whose leg was crushed than he does Jesus as he is distressed to find.

F., 20. Now pities most those who are having a struggle to give up and stand for Christ; has never wept so piteously lately as over a graphic narration of the two women claiming one child, because she pitied the real mother.

F., 47. Used to pity Jesus, now pities sinners, and next to them young Christians who have to pray or talk for the first time in meeting, also backsliders and inert stagnant Christians. Pities those who are taking wrong views and acting on them.

M., 54. Is utterly callous to all kinds of passion stories, because he was too early inoculated.

M., 28. Who used to be deeply moved but is so no longer; thinks it is because he has really, though half unconsciously, ceased to believe them.

Several pity most those who feel themselves lost or think they have committed the unpardonable sin.

What are the attributes or environments that increase pity? The rhetorics tell us of the effects of a noble demeanor, of a sensitive nature, of culture and refinement. These are increased by dignity, silence and non-resistance in the victim, although Kirschmann urges that the hero may be too exalted to

be thoroughly pitied. A high-toned quietism that is not easily roused to vengeance; the poise that faces torture without excessive agitation; that foresees, yet controls, or represses all show of fear; the heroism that takes for duty's sake pains that might have been avoided; that stands at the post that fate has assigned with heroism and fidelity; the stoic's imperturbability developed in an age of declining culture when the great goods man had striven for, and in some measure realized, seem doomed to decay; but when with perfect loyalty to their highest conceptions of human dignity the philosopher found resources not accessible to the common man that partly compensated for and in part exalted him above pain.

All this is greatly increased if the individual is entirely innocent and even sinless, so that deserving perhaps of all good that can be conceived he suffers all the ills that misfortune can visit upon man arranged with diabolically artistic and cumulative effect. The world is more or less familiar with suffering for the sins of our ancestors by heredity, and the curse of Atreus line has played its great rôle of havoc in the world of tragic sin, guilt and atonement, until even this is not novel to the degree of being unique. When, however, the sufferer is represented as spotless even in his heredity and yet enduring the greatest evil with a bearing and spirit instinct with the conviction that no ill can befall a good man living or dying, the very acme of pity and pathos is attained. Neither art nor history has anything more moving in this line. It would be interesting to inquire in detail with all the resources of modern psychology whether the death of Jesus as told in the Gospels could be made more pathetic. The melting thought often is that all this tragedy of woe was spontaneously undertaken in our service. Current Christianity utterly fails to realize the power of pathos, what it can do and what it has done in the world. Whatever else the pathetic motives of Christianity are, the story of its central figure will always be a masterpiece of pathos, indispensable for every study of this sentiment. The scores of the adumbrated efforts of the magicians to reproduce its miracle of transformation of the heart by legends of martyred saints also attest its potency. Most of us now-a-days are too comfortable to be tortured by pity.

Many reports specify a pathetic *depression at twilight* when "the day is past and gone and the evening shades draw near." The garish splendor of the sun is out. It dies in brilliant hues below the western horizon. The potent stimulus to all activity that comes through the retina is reduced, darkness checks activity which it is so hard to secure in blind children. Heat is reduced and with it various physiological processes, which

mark the rhythms not only of day and night but of summer and winter; and as Arrhenius has lately shown of nearly monthly periods of atmospheric electricity or as Gaule [1] discovered of the nightly vanishing of the testicular fat corpuscles of the frog. Night is more often below the optimum of temperature and we can very easily conceive, as Max Müller urges of the primitive Aryans, that for some perhaps very extended time mankind felt fear each night that the sun could not escape its nightly subordination or extinction and usher in another day. Night is the mother of many inveterate fears and superstitions, which like darkness tend to substitute passivity for activity. Our very organism at twilight feels the strain of turning from the freshness and many hued brilliancy of sunlight to the blackness and danger of night. Some so longingly anticipate morning that they dread to sleep and regret that mankind is so made as to have to spend one-third of life in the thralldom of darkness and so near to death.

Another factor of the twilight psychoses is that the activity of the senses is diminished and the momentum and energy of life are thus turned on to the higher processes. Memory reflects the past and hope performs the future. It is the time for deliberating, for making new plans and readjusting old ones. Nature seems to directly invite reflection and introversion. On the one hand we think with the tenderest pathos "of the days that are no more" and idealize the future. It is the pathos that of yore was formulated in the death of Balder, and if Müller is right, several hundred other gods of the sun and day. These sentiments are the soil out of which sprung the sad and wild dithyrambic wails for Dionysius and Proserpine. In twilight, solitude is oppressive; we doubt our own senses and powers; difficulties loom up; the falling darkness typifies and prefigures old age and death. Twilight pathos is thus one of the oldest factors in soul life and gives to it a diurnal range and sweep, for in the morning we are at the top of our gamut of moods. The old fears, doubts and depressions have all vanished. In place of the widened correspondencies in time and space, the life of the senses is reasserted and immerses us in the present.

Some can never be alone at twilight; others try to shut it out by closing windows and lighting gas early. Bereavement makes it harder to bear; love often deepens and intensifies it. When candles are first lit, children are sometimes organically intoxicated with joy, not knowing that it is because artificial illumination has seemed temporarily to reverse the process and herald morning. Some have a passion for going out for noc-

[1] Centralblatt für Physiologie, April 28, 1900. Ueber den Einfluss der Nacht.

turnal activities; where it suggests love, it is generally a chastened, sad or calamitous love. Some delight to immerse themselves in the sentiments of the hour and seek solitary country places to get its full effect, and one reads the poetry of twilight and takes pleasure in pitying herself. One wishes night came with a bang at a certain hour, for twilight seems like smothering slowly the life of the soul. Others revel in the sentiment of resignation and trust in a higher power which it invites. Some fight its influence by imagining vividly scenes and occupations of the next morning. One refined lady states that she is so melancholiac that she is afraid of doing violence to herself every twilight during a certain part of the month. Some think of their dead friends and review their past life, play or sing sombre music. The love of the sentiment of pathos and pity is perhaps nowhere more strongly seen than in these twilight psychoses.

Autumn. In the fall, when the leaves turn yellow and red, which is their gray hair, and begin to fall, when the flowers wither and vegetation becomes seer and frost bitten and autumn hues and beauty fade to the brown nakedness of winter, feelings not unlike those of twilight are strongly developed. Man has a close and sympathetic rapport with plant life and when this dies, a great link that binds him to his world vanishes and he feels more isolated. Only fellow beings and animals can now rouse any sense of companionship. As cold increases, it suggests some interplanetary absolute zero or the future fate of this earth, when mankind will be slowly chilled out of existence as the vegetation has been. External nature is less attractive and thought turns inward upon itself, husbands its own resources and very likely as a result of their inventory finds them pallid anæmic as compared with the freshness of objective summer life. More time is spent within the walls of the house; some girls declare that they could never love a man well enough to marry him in the fall; others confess to a tinge of depressive melancholy that makes nothing seem worth while; some dread winter like death and long to migrate southward with the birds. One cannot read accounts of an arctic winter without nerve shattering symptoms; one distinctly for years feared each fall spring would never come again and was greatly relieved when she could realize by a noon mark that the sun was actually creeping northward. The year is slowly and naturally dying of old age and the fall suggests funerals, yet one correspondent prays that she may not die in the fall. In the spring all this is reversed. Joy, gladness, hilarity, activity, as of those released from prison is described. Spring seems a victory; fall a defeat. I always wanted, says one, to have all possible fruit and crops gathered,

so that if spring should be delayed or skip a year we would not die. Why, another asks, did men ever leave the torrid zone, life can never be really tolerable where there is a long winter and snow? My dread of winter, says one, is a positive phobia; the first cool day in the fall fills me with shuddering, apprehensive dread. I at least have to think mankind in general were not made to go through all that the winter brings. Its very sports ring with a hollow and falsetto note and seem unreal diversions and palliations to relieve the gloom of the situation. No Christian ever longed for heaven more than I long for spring, and to be compelled to live in an eternal autumn would be a hellish refinement of torture.

In nearly a score of our returns, a special pathos is ascribed to the simple *lapse of time*. We can move up and down, right or left in space, we can swim against stream or tide, but nothing alters the steady lapse of time that moves on toward the inevitable hour whether we strive or sleep. Time can never turn backward. Faust's prayer to a present moment to linger, it is so enrapturing, can never be answered. Freedom avails nothing against this iron law of fate. Every moment we are nearer the end than, as the song has it, "we have ever been before." Every tick of the clock or every vibration of the kymograph recording thousandths of a second is a death knell of an irrevocable section of our lives. Every pulsation is the muffled drum beat of a funeral march; every respiration counts one off the total number of allotted breaths; we are always growing older; childhood and youth are always sinking below the horizon and still the tide goes on forever from eternity to eternity. Everlasting is a creepy word; it is a magnitude beside which the longest life is literally infinitesimal. Few want to go back and repeat, but most feel at times the utter pity of it all and long to turn back the cycles, as Plato feigned that the old shall grow young, gray locks become brown, and all temporal sequences be reversed. To some the sense is utter helplessness as if life was held by a stern iron grip and all constraint with no liberty. To others the fear of the last hour periodically looms up in a vivid and agonized way as the end of everything while to others the vanity of life seems greatest from this standpoint.

The pathos of *regret*. Many things in the past might have been otherwise and the Maud Müller "might have beens" sadden hours in many a life. The sense of freedom makes us feel that the past abounds in turning points or cross-roads where we might have selected very differently. Plato's fable of souls choosing their lives before birth expresses the possibility of

various careers as inhering in each individual. Regret is a kind of self pity and takes two forms: the first that different courses were not taken, and the second that the early dreams of youth in the directions that have been chosen were not realized; that in current phrase we start to build a temple and find in old age that we have only constructed a woodshed caricaturing the temple pattern. The pathos of unrealized hopes and ideals is one of the most sobering factors of mature life. The adolescent thinks he can actually reach the pole star and perhaps hitch his wagon to it, but finds he can only use it as a point of direction. This is the spring of many a pessimistic note and is a prominent factor in such philosophies. I might not have been, *e. g.*, round shouldered, short sighted, with feeble digestive powers, with pulmonary troubles, should not have been poor, obscure, etc., if I had done differently. Some pity themselves for what they are and some pity their own childhood that it was so cramped, exposed to such hardships, or so uncontrolled and prodigal. Why could I not have known this, or why did I not do that, leads some to blame parents, teachers, society, the world, God; makes them anarchists, ungrateful to relatives, blasphemous toward the divine, when the sole fault that they are underlings is in themselves. The writer believes that there are thousands of obscure men just as gifted by nature as many of those most famous or successful, who are victims of circumstances which they could and quite as many more which suffer from those they could not control, and that there is thereby great loss in social economy and efficiency.

The explanation of all this is to my mind obvious from the standpoint of an evolutionary psychology. Just as man's feeling instincts are larger than his consciousness, so most souls have much raw material of eminence that is entirely undeveloped. To unfold in one direction compels non-development in others where perhaps the possibilities are just as great. Each has the seeds of a multiplex personality; we all could have been quite as good and done quite as well in one or perhaps many quite different spheres of life, and the dim groping sense of this is what makes the sadness of many of the "might have beens." Some do not live out the successive developmental stages of their life fully enough to motivate development on higher planes, others live them out too fully for the interest of the next plane. Very deep and very strong at any rate in each soul is the conviction that whatever fatalists may say about the impossibility of anything else having happened in the world other than what has happened, every life is in many a direction undeveloped and incomplete, and that the destiny of some has been diverted and perverted.

Race pity. One writes: I have never pitied the estate of man so profoundly as when I first read Hartmann's account of the three stages of human illusion. In the first he says man hoped to be happy later in his own individual life; maturity or old age would bring what had been previously denied, but as generations passed he realized that the future millennial or golden age was not for this earth, and so heaven was either invented or grew bright as an asylum of hope that was bankrupted here. Earth is at best a vale of tears and sorrow, but in the hereafter all this is to be richly overpaid by transcendent joy. Later he found that this was a mere mirage or projection of his mind on the cloud field of his wishes, and then evolution seeks in some measure to save his dream of happiness by assuring him that although the past and present has little save wretchedness in store for him, his posterity will be happy in some far off and glorious state toward which all things tend. This third illusion, however, soon vanishes as he comes to understand that earth is a moribund planet on which nothing can live long and is doomed to be like the moon, a floating cinder, where life itself is impossible. He sees that this is the be all and end all; that man is a pillar of dust thrown up by a rude whirlwind; that the sturdiest swimmer of us all is doomed to sink at last with bubbling groans into unknown depths. If this is so, man and his whole history is the most pathetic thing that can possibly be conceived. All the ideals that make it tolerable are a sham and lie, and the only philosophy is that of Bahnsen, Mailander, or the other miserablists, and the highest duty ought to be to kill all our friends and then ourselves, for no stoic imperturbability can avail against such a fate.

M., 50. The Waldenses, whose extinction was ordered by Innocent the VIII in 1485, and the sickening record of entrails torn out and a fierce cat put in their place; delicate women who were buried alive or bound and left to die in the snow; men whose sabre wounds were filled with quicklime; tongues torn out; matches thrust under nails, in nostrils, and between lips and lighted; heads blown off with gunpowder with which the mouth was filled; innocent people broken on the wheel and quartered; babes subjected to every cruelty that human wit could devise—this makes the most pathetic chapter of history that I know. Yet this is only a faint symbol of the way nature treats man.

M., 58. Our barbaric imperialism, our conceit of the holiness of our peculiar civilization worthy of the followers of the Mahdi, as if anything could have value anywhere that had no native historic roots; the destruction at Luzon of the sacredest thing in the world, namely, the spontaneous budding of a national life, and our policy of destroying the souls of these people, even more than we do their bodies, makes me sick with the utter pathos of it; to impose our utterly alien ideas as an act of charity, and with rifles and artillery, is a hideous buccaneering business which sometimes drives me frantic with its unutterable pathos.

Siegfried's book on misery, pure and utter and dumb, which shows

how men are goaded by starvation and despair into mad revolutions, filled me with the passionate pathos of human life.

M., 42. The close of the Old Testament: "Lest he smite the earth with a curse;" the story of the Accadians so oppressed in every activity of life by fears of the dreadful Maskim; mankind oppressed by superstition, as Lucretius describes them; the hardships of primitive man, cave dwellers, in the bronze, iron, and stone ages; the pathos of the people in Turkey pillaged by tax-gatherers; the downtrodden masses of Russia; of ignorance both where education is desired but in vain—and there is not intelligence enough to want it; the sad state of man in the days when Boetheus wrote his consolations of philosophy; of the poor people who lived before Christ, without hope or even knowledge of salvation; for the myriads of lost souls in hell; the literature of pessimism that man is dying out, decadent, degenerate, and depraved; the new scientific conception that he is only an infinitesimal microbe, a parasite on a planet so small that the gods could not discover him if the sun were the objective of a great cosmic microscope for a divine eye.

Self pity. There is a sense in which we can fear and can be angry with ourselves and we can certainly love self. Can we ever properly be said to pity ourselves? The child who strokes a hurt and says "poor baby," is playing the rôle of mother to itself and pities itself only so far as it simulates another. In maturity people often pity their own childhood which may even seem pathetic for its deprivations or for its mistakes. This is in part regret that they had not known or had greater opportunity, and this is so near to pity that it is hard to discriminate between them, and those who would eradicate pity from human nature are yet more strenuous in their denunciation of regret as always vain. "What a pitiful little creature I was, I could weep over my folly and hardships," is the burden of some returns, but this is always a counterfeit or at best an alloy of pity. One part of us cannot pity another part in the full sense that all of us can pity all of another. One cannot completely objectify self. In many prayers we pose for divine pity as worms of the dust, conceived in iniquity, totally depraved and prone to sin, utterly sick, with no help in us, seeking to draw divine compassion from the sky as beggars magnify and show their wounds, sores, diseases, rags and squalor; but this is partly convention and not whole bottom-hearted sincerity. Lucretius and modern pessimists bewail the state of man. A modern evolutionist describes our race as microbes and parasites of an infinitesimal dirt lump, which a divine eye could not even see if the sun itself was the lense of a celestial microscope. But this is in part a rhetorical affectation. The mediæval ascetic sometimes seemed almost to pity his soul for being tethered to its vile carcass of clay. The question here is whether any of these sentiments can be properly called pity, though their reduced volume be admitted. Does the fact that such feelings are directed toward ourselves give them a different quality? I

think not. Each has a definite image of himself in the past and in the present in a certain environment whether doing or suffering. That image is certainly as near reality as the image of others, and I see no reason why we cannot pass judgments of compassion upon ourselves as truly as we can pass æsthetic judgments upon our beauty or ugliness or moral judgments upon our characters. We have never been told that it was our duty to fear, love, pity, be angry with self, as we have immemorially been told it was our duty to know ourselves. Self knowledge involves self objectivization, but self direction of pity is less intense for many reasons. First, feeling absorbs the self more than knowledge does. It is more subjective and less objective. The strongest feelings, although arising within and absorbing the soul, are those that are directed to something without and only the noetic faculties are readily reflected inward.

Is pity ever *spontaneous* or does it always require some stimulus? This ubiquitous and irrepressible problem is as difficult in this field as in others, but no more so. The organs of pity, whatever they are, seem sometimes so loaded and unstable, that they discharge with great intensity at a trifling stimulus. One young woman wept because a woman, who obviously needed an apron in her work, had none. Another was melted at the threadbare coat of a proud and once rich man. The first gray hair, the slight signs or crack of age in the voice of a singer, the glance of the eye or tone of voice in a passing stranger, the sight of plain food set out for unknown eaters, the suspicion of a sigh, the slightest sign of a groan, and many an incident no less trivial echoes and re-echoes in the recesses of the soul like the "lost chord." Whether some moods of the autumn, twilight, "might have been;" some of the factors or forms of ennui, home sickness or self pity have pure spontaneities of this emotion in them, our psychology is as yet too crude and undeveloped to tell. There are also problems here which cannot be answered until we know how far one sentiment or emotion can act vicariously for another and also which are more primal and which derived and compounded. There are many human experiences that seem to suggest that the sentiment of pity sometimes suddenly awakes into great and perhaps life dominating strength, where it had never existed before. Men seem to fall into pity as they fall in love and enter on missions, take vows, etc., accordingly. We know that the feelings, very different one from the other, still are based upon physical manifestations that are quite similar, and also that some feelings act for others and also sometimes predispose to their opposites by contrast, and this makes the problem very difficult. On the whole, however, we incline to the view that pity may be almost, if not entirely,

spontaneous, and even lavished on objects that normally provoke the opposite sentiment, and also that it is only less primordial and distinct than fear, anger, and love.

III. Psychological.

Like all feelings pity cannot be dissected from all other psychic content and be presented alone, and perhaps it never exists in a pure and unmixed form. This may account for the confused and often diametrically opposed views held of it. In general, pitifulness is thought a good quality, a sign of a tender heart and high moral breeding, and yet there are many who would eradicate it on the ground that it tends to eviration and interferes with evolution by preserving the lowest specimens of the race who ought to be eliminated. If both these views are right, dummy objects on whom we could exercise the sentiment but which remain unaffected by it would be desiderated. These contrary views interfere with both the objective and the subjective effects of charity. Both have their truth, and the adjustment of them is the problem, not of principles, but of individual cases. Another antinomy here is that we often pity others who lack what we at that moment are oversated with. Our very comforts start compassion for those deprived of them, and yet we pity most where we have ourselves suffered most. Premonitions of personal pain would, therefore, seem to be most favorable for pity instead of being so removed from the want and pain that satiety has supervened. If our own experience with pain makes us pity most, it would seem that present suffering, at least in some, if not in an extreme degree, would be requisite for keenest pity rather than the pallid images of memory. Yet acute pangs make us selfish and kill pity. Again most of us are angered if we find ourselves pitied in most conditions and by most persons, and yet by others and in other conditions we love and court pity. Probably all are acquainted with both these sentiments; some lives being balanced more toward the one, and others toward the opposite extreme. Again overdrafts of pity may provoke even anger to the point of cruelty and yet pity and anger seem to be almost as opposite states as love and hate. Again fear is a measure of pity if we grant full scope to the principle that we pity in others what we fear for ourselves. This law, however, valuable and true as it is, is of limited range, for in our protocol of material there are abundant cases of pity with not only no conscious, but no possible danger to the pitier. Love and pity seem twin sisters, yet with the full efflorescence of each the other is inconsistent. Once more, we even pity what we ridicule, and laughter and pathos make a well known psychic compound. The mother, whose boy's leg had just been set when itch broke out under

the cast, could not refrain from laughter amid her tears, so in Rigoletto or the fool's revenge, we have a similar complex. Is there in these cases an alternation of one state with another quite distinct from it? The attention and all the apperceptive elements may fluctuate, and this suggests a single simultaneous but complex state, but the resulting emotion is an alloy of two elements with even many physical instruments in common. The view of Hobbes, that one ingredient of pity is joy that we are not as the objects we pity, seems also to have a very partial truth despite the fear that we may sometime be in their place. The old problem, whether pity and pathos are pleasurable or painful, also can never be settled because wrongly put. All strong sentiments make us tingle and glow with an increased sense of life, and even melancholia which is a depressive state may exalt by its mere excitement in the acute form and thus be not without agreeable symptoms. Young people often read or think over the most pathetic things they know in order to glow with pity, and reproach themselves because this feeling is not keener, and this is most liable in the age when boys affect stoical and callous ways, hate most to have their feelings played upon, and their very instinctive shame of feeling testifies, if not to its bad quality as some have urged, at least to its strength.

When we reflect on all this intricacy and realize the depth and breadth of the emotional side of our nature, the difficulty of discriminating its symptomatic physical expressions one from another, and the reference now in vogue to changes in the sympathetic nervous system in circulation and reflex innervation, the problem seems so vast that we psychologists perhaps ought chiefly to pity ourselves and I confess at times, as I do now, how poor, weak and utterly inadequate all the resources at my command are to fathom such abyssmal processes of the heart. Yet psychologists now must face these and triumph or decay, according as they can make progress in resolving them. We turn to novelists, dramatists and even poets with little avail. The two former especially are for the most part wooden, conventional, and produce their effects by very simple and very stereotyped and threadbare means. History and life are infinitely suggestive, and the great among them, like Shakespeare, are so because they elementarize less and present nature less stripped of its complexity and with more fidelity to the multifariousness of life itself. Repeatedly I have devoted summers to novels or evenings to plays, popularly supposed to be profound in psychological insight, to find only the husks of convention and cheap fustian or mechanical daubings with flaring, loud and vulgar primary colors. I can see no way of progress here, that I deem more promising than stated conferences of those most carefully bred by culture, nature, or both, old enough to have

ripened experience, patient enough to persist and humble enough to be content to make a modest contribution. Our psychological associations, at least, to say nothing of organizations for the promotion of other sciences, are neither psychological or pedagogical here. Individual experience is not large enough to grapple with these problems; the pooling of many wide ranged and deep individualities working together from their diverse points of view seems to me a new psychological method, which might be as effective as laboratory or clinic in the advancement of psychology. The heart which is so much larger than the intellect, is the organ of the race while the intellect is only that of the individual, so that we need the fruits of the deepest life experiences of the best endowed souls most richly freighted with self knowledge and with all the information that science, literature, art, professional training, etc., can give, and I maintain that the utterances of the mouth stimulated by the sharpening countenances of friends in dialogue are better than the long circuited pen products of musty studies and solitary easy chairs. We are not in earnest with psychology, but only lately playing at it, and must change our tone and tension if we are ever to discover the depths of the soul which pathos stirs, and be mindful of the wholesome rule that if we would know others' body or soul we must study our own, and if we would know our own we must study others.

Most German writers on æsthetics during the reign of the ideal philosophy interpreted pathos on the narrow basis of Greek Tragedy. There must be a conflict between the individual and fate. The hero wages sometimes at first an offensive but more commonly a defensive warfare with destiny. Sometimes, especially in modern or more unclassical art, he may be the victim of chance, caprice, titanic or satanic powers, furies, demiurges, Seva, Ahriman or even of ghosts and vampires. There must at least be a controlling power set in the scene that is not only dominant over man, but more or less blind and irresistible. These manifested the good pleasure of the gods, but the more demoniacal or sublime they were the more they exalted, while they crushed, so that the sublimity of the action always tended to leave the characters more or less above the ranges of common life and homely sympathies. At the end after heaven storming titanic ambition had perhaps inflated the sphere of self beyond measure or proportion, the one law of heaven and earth, and after all misunderstandings, the conflict with the absolute was always resolved in the end by some kind of atonement, and finite and infinite aims were brought into coincidence. For Schopenhauer the understanding is the rebel leader of revolts to be subdued in the end. It leads the self to forget that it is

only an empirical appearance of the will which back of all noetic processes is always maintaining its metaphysical unity and identity. The estrangement, alienation or heterization of the individual from the whole and the ultimate reconciliation is well illustrated in sex love, which from the standpoint of intelligence seems the most personal thing in the world, but is really, when we penetrate the illusions, seen to be in every item dominated by the interest of the species.

A recent art critic[1] develops the theory that all men of genius have their psycho-physical organism attuned to an unusually exquisite degree of sympathetic vibration with all the facts of life, especially all near the poles of pleasure or pain. Their impressionability is such that they rejoice and suffer with all human experiences. Their resonance is greater than that of others, and as pain is the great stimulus that has toned most human experience and has more variety and intensity than pleasure, so the gifted soul is swayed more deeply by human suffering. Faith, psychologically interpreted as well as genius, might mean a "pathos of resonance" which lies in the realm of the feelings and instincts rather than in that of the intellect, and there is a possible mystic sense in which life itself is a kind of resonance.

Very interesting are the unique pathos effects of a *sudden* and complete solution of story tensions where complete harmony is sprung upon the spectator or reader without preliminaries, preparation or expectation. A long feud in the west between the Jones and Harrison families, which resulted in many deaths, was suddenly ended by a handshake over the bodies of two children amidst scenes of strange pathos. The revelations of the beneficence and disinterestedness of a long course of action by a girl, which had been interpreted as a malign plot, and many other cases where the mind tuned for conflict sees suddenly cordial peace, friendship, love—this wrings the heart, as again in the atonement of Goethe's Iphigenia with Thaos, the delayed tenderness of the king's daughter in Schiller's Diver, the denouement of Tristram and Isolde, Max and Theckla, Romeo and Juliet, etc. Horwicz[2] and Zeising[3] specify sudden rescue from danger, or pardon on the scaffold, as illustrative cases of the pity resonance. Nor need it be complete at once, but the first intimation of it is often effective.

The time has now come when this great truth must be interpreted in a more *biological* way by the insight that the purest tragedy in the world is found in the manifold methods by which

[1] Otto Lyon: Das Pathos der Resonanz. Leipzig, 1900.
[2] Psy. Anal. II Teil. 2 Heft. p. 306.
[3] Aesth. Forsch. p. 348 ff.

nature and history apply their reductives to self consciousness and select for survival only those whose individual lives conform most closely to phylogenetic needs and laws. The race dominates all, and its penalties meted out upon the multifarious outcrops of egoism constitute the pathos of the world. Only where suffering does not have this corrective tendency or result is philosophic or biologic pity justifiable. This, however, leaves it the immense field of suffering, which neither individual nor heredity cause or need. Pity should not interfere with the august sway of justice in expiating guilt, and the fact that man cannot fathom by his science all the operations of this law, and that where they are seen in process of execution involving pain to those near us we cannot conform our conduct to them, shows how far man yet is from his ideal development in this direction.

The *pedigree* of pity is hard to trace. Sutherland's[1] genesis of sympathy, which he thinks the root of all the moral faculties, is highly suggestive. As parents formerly grew interested in their own eggs just in proportion as the young grew few, so that attention could be more focused upon them, offspring came to be felt more and more to be truly prolongations or projections of parental life. Sympathy developed to a higher stage when the young were viviparous and a great step up this aristogenic path was taken when creatures became warm blooded, appreciated and profited by physical contact with each other. The increased duration of parental care, which Weismann and Fiske have developed, and also the long tragic evolution of conjugal sympathy gradually unfolding from the sporadic outbursts of sexual passion, have built up other compartments in this enlarging mansion of the soul.

It is a significant and unique fact that *excess of joy* often brings pain, tears and pathos, if not an element of actual pity according to the principle of *die Wonne des Leides.*

> "Alles in der Welt lässt sich ertragen
> Nur nicht eine Reihe von schönen Tagen."

> "Fühlt, wie das reinste Gluck der Welt
> Schon eine Ahnung von Weh enthält."

Our returns show several striking cases where excessive and sudden pleasure, especially when unexpected but realizing some long deferred or ardent wish and ideal, brings tears. It seems as if to touch the highest happiness for us suggests either its vanity or the adamantine limits of our capacity for enjoyment. Perhaps this is an intimation that there is a rapture in

[1] The Organ of the Moral Sentiment.

the world infinitely beyond our power to secure or know it. This dim foreboding admits the poetic interpretation that somewhere, at some time and some how there is an existence as far beyond our own in its susceptibilities of pleasure and pain as our capacities in this respect are beyond that of beings far beneath us. Such tears are a kind of self-pity. The pain is in the vague feeling of our own limited abilities which are so wretchedly inadequate to the possibilities of the universe, and unable to react up to the level of these, and the pleasure is in the sense that there is a realm of such transcendent bliss. This latter may be disinterested, or it may involve a deep instinctive hope or prophecy that our nature may eventually develop to be an adequate organ of expression or at least of response. At root it is the race in the individual.

The theory that there is some strange, spiritual, or even neural interference between sentiments or waves of pleasure or of pain has slight explanatory power. Great beauty is pathetic. We have records of children, who like Beth, because of the sheer beauty of the blue sky, green grass, gray mountains, dazzling clouds, molten sea, burst into passionate tears.

From a carefully prepared table by Mr. Saunders, the following *symptomatic effects* are listed in the order of their frequency:—appetite, 103; sleep, 78; general depression or sadness, 68; respiration affected, 46; sobbing, 34; lump in the throat, 33; pulse, 40; pale, 40; tears, 29; indigestion and appetite, 22; chills, 22; heartache, limpness, thrill, throb, surges that rack the body, clutching of hands and at the heart, recurrence in dreams, bladder effects, are mentioned. In another table are recorded symptoms noticed in others, but the order differs little from this. Expressions occur like "I felt a smarting and burning in my eyes that grew wet;" "something within me was ready to burst;" "my heart seemed to stop;" "suffocated;" "lost control of voice;" "a stuffy feeling;" "the heart beat strangely and irregularly;" "a weight on the chest;" "tightness of the heart cords;" "pressure on lungs;" "blood hot and cold by turns;" "dart through the heart;" "hollowness in the stomach;" "contraction there;" "heart in the throat;" "not unlike a hungry feeling;" "oppression in the abdomen;" "sinking in the stomach;" "tired out;" sickening feeling;" "could not cry or speak;" "weakness of knees;" "drawing down corners of the mouth;" "lips and throat parched;" "wrinkling the forehead;" "want more air;" "great wave that goes over or through one;" "groaning and sighing;" "shaking head and hands;" "sharp pain in the head;" "sense of helplessness, restlessness, depression;"

"gooseflesh;" "nausea;" "quivering all over;" "face contracted;" "flow of perspiration."

Many of these exert some influence upon attitude, facial expression, respiration, circulation, rhythm of motion, vocal expression, and the least trace of these effects if perceived by others is the most immediate and potent medium of contagion of the emotion, even more so than interjection. We experience all these sympathies by infection from our friends and sometimes sob with them, not knowing the cause. They are less easily simulated, older than all speech and more primative, and confirm Horwicz' view that the action of psychic evolution is first the special feeling then a general one, and third the idea or concept. If the feelings are based on or consist of this physiological accompaniment on the sorry-because-we-cry theory of Lange and James (which, strange to say, Sutherland has worked out more fully than either and independently) and if real progress, in scientific explanation must start here, the outlook, from such scrappy and confused data as the above, is, it must be confessed, not bright. There are, however, here some opportunities for psychologists of the speculative arm chair tribe.

Garofalo, Lombroso and Benedickt have maintained with great ability the thesis that criminals, especially those who commit crimes against person indicative of cruelty and moral insensibility, are likely to be especially obtuse in their sensibility to physical pain. Analgesia in greater or less degree seems to be a congenital trait in the case of many who are especially pitiless. Physical obtuseness to pain, it has been urged, is not only a concomitant but a cause of heartlessness, so that those who readily feel pain do not readily compassionate suffering in others. Lombroso not only holds to this direct relation between moral and dolorific insensibility, but thinks criminals are often more disvulnerable than others and can endure and recover from more serious wounds or operations.[1] He even intimates that the greater capacity of women to bear pain accounts for the love of torture which some of his more monstrous cases display. This, of course, was suggested by Aristotle who in his Rhetoric develops his well known theory that the sight of others in pain calls to mind or to the imagination a copy of the sufferings the spectator would experience under similar circumstances. This relation seems highly probable if it be restricted to a lack of sympathy for just those kinds of dermal, sensory or other pain for which the subject is obtuse. If we assume that relative analgesia in the sphere of one sense is likely to be accompanied

[1] Lombroso: L'Homme Criminelle, pp. 109 and 322.

by the same in the sphere of the other senses or that physical is a true index of real moral obtuseness, the larger generalizations of the Italian school have great plausibility. We know, too, that the deaf are often thought especially cruel to their mates and to animals, when this is at least in part accounted for by the fact that they cannot hear the cries of pain which they cause and are therefore unaware of the suffering of their victims which otherwise they would feel very keenly. Among adolescents of certain criminal propensities who are analgesic, there is a distinct tendency to despise those whose sensibilities are delicate as inferior beings lacking in the normal hardihood, which they sometimes feel called upon to develop by severe discipline.

There seems great likelihood that the converse of this principle is also true and that those who are hyperalgesic or abnormally sensitive to pain are most prone to morbid excess of pity. This sentiment has its pathology in those whose nerves are overstrained by too frequent sufferings of those about them and also in those who imagine acute pain, where it does not exist at all. Hysterical frenzy over the frequent pains of pets; the vivisection of frogs and lower forms of life, the development of the nervous system of which gives us the strongest reason to believe that they suffer even from mutilation incalculably less than man; sympathetic pains which in over tense souls cause states of consciousness utterly intolerable, which may even seek relief in suicide, in blaspheming the order of nature, in senseless crusades to assuage fancied pains in the lowest creatures causes a volume of needless suffering, especially among those who lack purpose and occupation or whose imagination is too vivid for their common sense, and these monstrosities of pity, it is, that have long prompted certain theories now becoming widely current that pity is itself a disease that suggests a low stage of moral psychic evolution.

Ferrero[1] thinks women are both most pitiful and most cruel. They have greatest ingenuity in torture, and savage women protract the pain of their victims as long as possible to eke out the joy of vengeance, which they never wish to wreak like men by killing all at one stroke. They destroy by inches as over a slow fire, and in their fights wound more delicate organs that cause pain. In woman the extremes of pity and cruelty co-exist in unstable equilibrium. Her cruelty is due to her feebleness and she lacks power to repress outbursts of anger and vengeance. He cites the following among other typical cases.

Elizabeth of Russia compelled a lover, who betrayed her, to marry

[1] Monist, Vol. III, p. 220.

a deformed dwarf and to spend his wedding night in an ice palace, the furniture of which as well as the bed were of ice. The next day with her court she called to present a bouquet and found them nearly frozen, had the woman's ears and nose cut off and banished her to Siberia.

Ferrero tells of a Russian prince, who lived five years with a beautiful peasant girl whom he then discarded and compelled to marry a peasant. Ten years later in an insurrection, she led a body of peasants to the castle of her lover, had him harnessed to the plow and made him work for three days lashing him when he fell, stalling him with the oxen, making him eat fodder with the beasts, and laughing at him till he died.

Legouvé writes that the front rows near the guillotine during the French Revolution were reserved for members of the women's clubs. They hung to the boards of the scaffolds and drowned the cries of their victims with peals of laughter.

A poor servant girl, who could not read and write but had a genius for pity, founded *Les petites Souers des Pauvres*, which to-day counts 3,400 sisters, 207 houses, receiving and nursing more than 25,000 old men.

Jeanne Garnier, a heroine of pity, at twenty-three lost husband and two sons, after which she pledged herself to aid the sorrowing. She founded the society of *Les Dames du Calvaire*, which is composed of widows, who without binding themselves by religious vows pledge themselves to nurse the sick in hospitals and outcasts with loathsome diseases. The daughters of charity perform their beneficent ministry of pity all over the world.

The opposite of pity is called cruelty, which may be mere insensitiveness due to non-development, but in its true quality is a perversity which delights rather than grieves with others' suffering. *Schadenfreude* may be mischief, which indulges in mere practical jokes or teasings, it may deepen to the malice that not only makes man a wolf to his fellow man but shows great ingenuity in the invention of torture for which the resources of physiology are drawn on. Incredible as it seems to the normal soul, many a pervert is born and others developed by their environment in whose breasts the milk of human sympathy is turned to gall and wormwood. The Massochist derives exquisite pleasure from the very distress of his victim as did Jesse Pomeroy. The Newgate chronicles and other records of crime describe creatures who literally gloat over the sweat, gasp, groan and death rattle of their fellow beings, who have in nowise offended them. There are pain inebriates who lust for intoxication with the expressions of extreme anguish and study how to prolong the agonies of death, like Spadolino, who had mutilated and killed ninety-nine victims, and whose ambition it was to kill his hundredth man.

We cannot rank here the torture and sometimes butchery of younger children by others, many cases of which are on record that seem utterly heartless and abandoned. Here the joy that seems to have taken the place of normal pity is not purely malicious but is at least spiced with innocence. The nameless

cruelties recorded of rage and anger and even those of envy, which makes a page hardly less black; the vengeance that is not content with the death of its victim but vents itself on the body afterward; the most intense heat of righteous indignation which may be cruel, are wanton, sometimes gross intensifications of germs normal near the dawn of adolescence, but these are not the exact opposites of pity. All vindictive and retaliative pains that seek to restore the disturbed balance of justice like the daily anger assigned to God against the wicked; the real dangers often noted of telling our unusual joy or good fortune to our best friends lest his sympathy have a radical of pain in it; the just and righteous distress at really unmerited prosperity also, are not diametrical opposites of pity, but sometimes only wholesome regulatives and correctives of its excesses and perversions.

IV. Educational.

The *pedagogy of pity* opens a problem as large and difficult as its psychology. The two are almost inseparable. The stoics, Spinoza and Nietzsche would almost exterminate it or at any rate regard it as something of which the wise should be almost entirely rid. Spinoza thinks it is bad *per se*, because the perfect man will act only and never passively suffer. Aristotle wished the soul of the sage purged of pity as of terror, deemed it never a virtue *per se*, and thought it incompatible with fortitude, while other moralists hold that a chemist might as well do without fire in his laboratory as the ethicist try to establish a moral theory of the world without pity. No physician or surgeon should feel all the pains of his patient for his capacity to help them would thereby perish. Lessing revised with more vigor than the great Stagarite his doctrine that fear and pity were inseparable, whether for teaching, art or philosophy. How narrow and partial this is, what little we know of the pedigree of pity, to say nothing of the great Pitier who commissioned the heavenly comforter as at once his chief legacy and his substitute shows.

For Zeno, though not for Marcus Aurelius, the stoic sage is pitiless. Le Bon thinks solidarity of interests in modern society is better than the old bonds of sympathy, charity and altruism, so that pity is necessarily vanishing by the very contributions of modern political and social organization. Nietzsche intimates that God has his own hell, which was pity to the human race, that he died of pity which all great love is above. When the creator of the morals of the superman shall break the present tables of values, it will be found that we must "be a hard bed for the pain of a friend;" that we shall be ashamed when we see suffering rather than pity it, and shall see that great obligation makes men revengeful.

Educability is suggested by the fact that with the masses the most lachrymose and tear pumping results are often produced by homely and trivial incidents that often offend good taste, *e. g.*, Bret Harte. The slightest causes here often produce great effects. It is hard for pity once aroused to discriminate between the great and the small. The woe that pleases the great public and is wettest is domestic, popular and perhaps vulgar, and usually from any large point of view is very episodical. The quality of mercy in the fifth beatitude, that drops like gentle dew blessing giver and receiver, is not strained or aristocratic and seeks no warrant in the canons of the classic drama. Confelicity or *Mitfreude* is, however, as rare as comparison is commonplace and is far fainter and less educible or contagious.

Advocates of the elimination of pity usually cite and argue from cases of *excessive and morbid pity* which are due to unstable nerves, sentimentality, disposition and the habit of inactivity. Paulsen's account of a Russian countess, who wept at the theatre over the grief of a fictitious person, while her coachman froze to death ouside; copious tears over alien sufferings that is only imaginary; the lack of control which lavishes doles on beggars until they multiply, grow insolent and become helplessly parasitic on society, illustrate this idiopathic morbidity. While our returns give few examples, recent medical literature abounds in cases of what might be termed inebriates of pity, who gloat over suffering not because they are cruel, but because they love to be intoxicated with the rapture of woe. They hunger for feeling for the tension it brings. "My sentiments love to be strongly stimulated as a tiger loves its prey." Mankind in general prefers the literature of sadness to that of joy; the great epics, novels and dramas that are most widely read are those of pathos. It seems as though our race had developed modern civilization in which the pleasure field is so vastly widened and the pain field so greatly reduced too suddenly, and that our nervous system is not yet wonted to so much ease and luxury and had therefore to hark back to play over the old litany of sorrow and pain in the falsetto way of the stage novel and poem. Development in externals has been too rapid for internal adjustment, so that the new balance between weal and woe in the environment has not yet been struck in our organism. Our reveries are still those of the hard conditions of our past lives. Fiction, therefore, performs now the function of an Aristotelian carthasis in discharging harmlessly the virus of psychic rudimentary organs.

The hyperaesthesia of pity may have an opposite manifestation and turn with great aversion from every record of pain. Some cannot read the newspapers lest they meet the record of

accidents too strong for their overstrung nerves. One lady shudders and has symptoms whenever she hears the word—"suffering," "pain," "agony," or "distress," but especially cannot bear to read or hear the word "anguish," which is worst of all. Another can coquette with light accidents, but if blood or death are mentioned has symptoms that are so strong that she takes precautions to avoid them. Another made herself sing, although she was choking and crying, to please a dying friend, but could never hear sad music afterward. Two often weep at the sight of ladies in deep mourning; others seek to avoid all funeral processions; and for others pity is specialized toward some one or more diseases. King Max Joseph, of Bavaria, distributed one thousand guldens every morning, until his mania for charity had created hordes of beggars, some of whom lived in luxury while the needs of the most important state departments were neglected. While many seek with great assiduity to get away or avoid contact with pain because of the great suffering it occasions in them, yet most are especially attracted to sadness, prefer a sad play or story, enjoy crying with others even though they do not know what for. Others enjoy fancying themselves in circumstances of suffering which has a mingled dread and fascination; some enjoy the blues which they complain of, prefer the company of rather despondent people, while most are attracted only to the joyous and buoyant society.

To *assuage* the pain occasioned by extreme pity most seek diversion unless they can actually do something; they turn to occupations of the most different or even opposite nature; interest themselves in a novel; take long walks; seek to comfort others in place of the suffering they have seen; reflect how the trouble could have been prevented; turn to lively company; physical exercise; try to convince themselves that the story is not true; that the sufferings are imaginary or make believe; that it is all right in heaven; that it is on the whole best as it is or would not be allowed; some have recourse to prayer and concentrate their thoughts upon the future and an idea that all is for the best. All this shows instinctive efforts at self education of the heart which are the beacon lights of pedagogy.

So conversely and passively some *love and some hate to be pitied*. Schiller urged the pleasure of pity and the luxury of woe as a familiar theme of the pessimists. Duboc denies this and thinks it abnormal to find pleasure in the pain of others and still more so in our own. Children who present their hurt fingers to be kissed and made well illustrate how akin to pity is love, and adults are often so hungry for the latter that they feign grief, suffering, and invent long hysterical stories to capture the pity of their friends and sometimes inflict serious injuries

upon themselves for the same purpose. Grief, consolation and comfort, the very best form of which is the simplest expression of heartfelt sympathy, may be so effective and so satisfying that they create an abnormal appetite for more, especially in those whose lives are somewhat solitary and friendless, and who, unconsciously to themselves, fall into a pathetic tone of voice which is more subtly calculated than the most cunningly devised arts of mendicants to implore pity. Occasionally even those who have no other needs so crave compassion that they betray their hearts to the skilled observer in a way which would confound them did they suspect it. One woman in our returns is described whose every act, inflection and attitude seem to the recorder a plaintive appeal for pity, and her entire life, really on the whole a fortunate and happy one, was construed in this sense. Psychologically interpreted her life was a prolonged quest for the close interest and sympathy, which love had not yielded her, the succedaneum of which she found in pity.

Other hardier souls could hardly be more affronted than by any act suggesting pity. They not only resent every form of charity, but imagine and suspect elements of pity where they do not exist. One fancies a look of compassion in her more prosperous neighbor's face, when she meets her upon the street, which she repelled with cold dignity and which led to estrangement. Another refused money for a real service, which had cost him little time or effort, because he thought it a thin pretext to express pity. Helpers among the self respecting poor are put to their wit's end to devise forms of self help so subtle that the recipient shall feel that a *quid pro quo* is rendered in every case. This feeling has to be carefully distinguished from a more exterior pride, which fears only that the reception of aid shall become known. One young man declares that pity, even with toothaches or gripes, makes him mad, that he can stand anything else. Nietzsche's Zarathustra intimates that man has red cheeks because of his shame in receiving pity and its gifts. The merciful, he says, lack real sympathy with the self respect of sufferers and excessive giving prompts revenge, if only as a form of self assertion and resilience.

Pity was almost a profession with its own peculiar course of training in the later period of ancient Roman history, when the *art of comforting* the afflicted was highly developed and the methods and even the literature of consolation have had their chief development along with the philosophy of sorrow and grief. This was especially for the benefit of the bereaved and consisted first of all in sharing grief. Professional mourners cried aloud and mutilated their bodies to take the pain of relatives vicariously. Sometimes real agony of pity was felt. It was no doubt

a certain relief to friends to feel that there were those whose sympathies were so trained as to grieve more demonstratively if not more profoundly than for themselves. Perhaps these still survive in the habitual funeral goers. Another method of the consoler was to simply sit beside or attach him or herself to the afflicted and seek to show without a word, but by every deed and gesture, all that the tenderest hand in hand companionship can do in halving sorrows. Others more assertively strove to gently divert thought and attention by suggesting or inventing little offices in memory of the dead, and taught that funeral rites were desirable in part because they gave a practical objective trend to the thoughts of survivors during the first few painful days. Slowly mind and heart were weaned from the dead to the living, from passivity to active duties; the needs of surviving friends were dwelt upon; neglected work, the needy and other ministries were pointed out. Occasionally the compensating advantages of death to the dead as a surcease of suffering, or to the living as opening new opportunities and wider spheres were indicated. Very commonly a larger philosophy was taught of which death was felt to be a great opportunity. It is our duty to accept it with joy, because it is inevitable and in the plan of nature. Death for the old is even an object of supreme desire and undue prolongation of life would be most pathetic. The ministry of pain is to teach us humble views of man's place in nature and to direct our thoughts toward eternal truth. A large optimism that all is for the best was inculcated and it is a part of every true sage not to be overwhelmed by grief. I doubt if our modern clergy have ever attained such proficiency in the art of ministering to grief. The value of the modern additions to the comforter's repertory of resources in immortality and eternal bliss of the departed, while it gives new and deep satisfaction to believers does not apply to all and is prone to be urged to the neglect of the more natural methods of diversion and increased closeness of ties of friendship, etc. The power of these ancient methods is great and abiding. The most newly invented comfort, which we owe to the spiritist conception that the souls of the beloved are near us or to the mind cure view that even the supreme evil of death has no reality, while its pedagogic value is no doubt real and great for some, rings hollow to most deeper souls to whom it seems tinsel, gaudy and even vulgar. A true psychology of mourning has yet to be written.

Pity for the dead who lose all the brightness and reality of life, the love of which is so fundamental, is a factor never absent but which varies enormously with the conception of the reality and nature of the transcendent world. If death is extinction of soul even before that of the body, pity lacks one comfort,

but even this is better than eternal life of pain. If the dead are conceived, as among the Greeks, as leading pallid and unreal lives of shades in the underworld, sorrow may be gray but not black. Very rarely have races or men really conceived death as a triumphant victory and as an occasion for festivity, joy and congratulation. The very thought of turning man's greatest defeat into his greatest victory, of transmuting supreme sorrow into supreme joy, is one of the sublimest of all conceptions, but alas! very rare and essentially only an affectation.

The *opposite* of the consoler's art is nowhere better represented than in the pessimistic Job comforters who seek to extinguish pity by invoking anger. Their invocation now is not to curse God and die, but to declaim against the constitution of the universe or of society and to taunt their fellow beings with the perverted gospel of miserableism that all we call happiness is but an infinitesimal abatement of woe; that truth, beauty and goodness are illusions; that life is a mockery and the best who take it most in earnest are those whom the gods have especially decked with caps and bells for their delectation.

Pity is prone to *specialization* in a way that shows its plasticity. This we see in our own proclivities toward pathos and in those of our friends, in literature and especially in the history of charities. Some sympathize most keenly with homeless or sick animals and found hospitals for cats, dogs and horses; the hearts of others bleed readiest for orphans; others feel most deeply for the blind, deaf or the feeble-minded; some devote their lives or their substance to aged sailors, soldiers, poor widows, to hospitals and the sick, to the aged, to ways of self help for the poor, the insane, saving the souls or bettering the lives of heathen and savages, for easing the way of impecunious students. No soul is large enough or balanced enough to distribute pity evenly in all the fields somewhat according to needs. This specialization may be due to individual experience or to the misfortunes of family or friends, and it is sometimes determined by local exigencies or by special claims of special classes, but I am convinced that there are cases for which experiences does not account and which seem to be essentially innate, rare though such cases be. Individuals differ constitutionally in tenderness of soul in different directions, and while experience does most and perhaps accidents of location follow next, there is a small residuum which seems as aboriginal as genius. Again pity in one of the above forms while it does not directly make us callous to the claims of other fields so vicariates for them that having helped one class we feel less pity for the others. There are, moreover, plenty of cases of great tenderness in one direction which have never even felt pity in the others. This,

and probably the theme of the next paragraph, is what the old teleologists would call a beneficent provision of nature, for no soul could possiby survive the depression of great pity for all the fields of human woe.

Pity fetiches are an interesting new psychic fact primitively due still more directly to plasticity. As is well known experts in sex phenomena are agreed that in certain cases the sight of a glove, shoe, or the feeling of hair, handkerchiefs, etc., have peculiar erogenic power which sometimes the normal excitants fail to arouse. I think our returns warrant analogous phenomena in cases of pity, a fact never noted before. I have read the poetic extracts and the descriptions of some of the pictures and literary and personal incidents cited elsewhere in this article, to many individuals of my acquaintance only to find that some are profoundly moved by things which leave others entirely unaffected. The cry of a child or a cat, a minor key, the downfall of stage snow, the piping of stage wind, scanty clothing, barefoot children in the late fall, a hole in dress, pants or shoe, or even a patch, may have very peculiar patheto-genetic efficacy. The feelings aroused by the thought of the nails of the crucifixion, elsewhere mentioned, for some; the thought of the word or picture *cross* for others; blaming, controversy and especially the sight of a blow struck under any and every circumstance may bring pity to the melting point. The only explanation that can be suggested for this group of psychoses is the conventional and more or less deeply rutted ways in which novelists, dramatists and others have played upon this feeling. We see this in religious music, where sometimes the most tawdry words or terms cause nervous effects of extraordinary power by using symbolic forms or types that have for generations stamped their effects upon our very nerves, and against which the judgment revolts. All such cases suggest nascent periods of exceptional impressibility vividly but accidentally stamped.

Irradiation and diffusion. Pity for those in the closest family relations where it begins and focuses readily irradiates to relatives and kin. As Morgan, Le Bon and others have shown, ancient society was founded upon the ties of blood, the sept, clan, tribe, gens, phratry, curia, patriarchate, etc. In these consanguinous units, solidarity was greater; the ties within were closer; the chasm between the unity of all within and outsiders who were aliens, barbarians, gentiles, etc., was greater. Modern society as distinct from all this is organized on the basis of property and competition of these in the same group; and blood ties, the strength of which is seen even in rude forms of the blood covenant, lose their strength, and pity, though it

may have a wider range, diminishes in intensity. Again there is a special sympathy between those of the same age—children with children, youth with youth, age with age, etc. Primitive society cannot pity the very old or the very young enough to prevent infanticide or the slaughter of the aged. Now compassion includes every stage of life. In the days of caste and classes, the social strata sympathized with each other, but the upper and lower ranks were not strongly united by this bond as in modern and more democratic society, where all are members one of the other and suffer and prosper together. Until recent decades criminals, defectives, paupers, and even the sick were neglected, so that the rise of modern charity marks another great step in the effort to remove evil from the lives of others. In place of a narrow chauvinism, men are striving toward that culture which essentially consists in knowing and liking foreigners and their ways. That humanism of the eighteenth century marks the point where man transcended national bounds and became interested in his fellow men as such. Thus we see how pity, which like charity begins at home, tends to irradiate toward cosmic dimensions. In so doing, however, its intensity and effectiveness is almost as inversely as its distance. Diffusion reduces and dilutes, because it is hard to love collective bodies. If we have become truly cosmopolitan, so that we can estimate the race value of such sentiments for man to-day, it is harder yet to extend the range of sentiment to the far past or the far future or the far distant in space. The struggle in pain of nature to bring forth the anthropoid and finally the human form; the distress of our own far future descendants or their extinction, which may be due to our vices; the pathos of possible life extinguished when fixed stars brighten up in conflagration, move us but little and yet feelings spread and have rare power to annihilate time and space. All this is suggestive of educational orientation.

Friendship and especially *love* are perhaps the best of all schools of compassion. A friend is a part of us; wife, husband, parents, children are extensions of our own being. We feel not only for but with them. The experience of their pain makes us quick and tender to realize the corresponding pains in corresponding members of other families. We sympatize with those who suffer what we fear not only for ourselves but for those nearest to us. To ward off evil to them is almost a part of self preservation and is a large part of the universal instinct to fight evil and to maintain and enhance our own happiness. Thus pity irradiates and contributes elements to benevolence, patience, toleration, chivalry, humanity and all the social traits.

The relations of *love and pity*. As a brutal and overmastering sex passion, physical love can be as cruel as anger with which it develops common factors. It loves resistance and forces its way with blood and sometimes slaughter. The fury that of old was let loose in the conflict of rivals may be vented on the weaker sex, and there is a sad literature of human animality devoted to this theme. But in its most highly evolved form, love tends to the opposite extreme of tenderness and the propensity to give in every respect the greatest pleasure is no less strong. I have nowhere seen any explanation of the above relation, but suggest that as the primitive family consisted of the mother and her child and that as the father came into it as a moral factor far later, that child love merged very gradually into husband love carrying with it pity, a dominant feeling in the mother's breast toward her offspring. Abhorrent as is pity to a manly man and desperate as the straits of a lover who finds he can only win his way to the obdurate love of his mistress by first working upon her pity, this course of true love in her heart is very natural and effective. Sick men who reciprocate the love of their nurses accept this situation. With man, on the other hand, love and marriage rarely develop from the basis of pity. The woman falls in love with her savior or protector in danger or with her physician far more often than he with her.

Moralists from Aristotle down have often also urged that *personal experience in grief* was necessary to lively sympathy with it. Only those who have felt bereavement or other stinging blows of fate can know how it feels just as Plato's good doctor must have been sick. Fortunate and pampered lives that know but little of disappointment, of penury, disease, hunger, cold, cannot so vividly picture themselves in these calamitous states, because they lack the apperceptive organ which interprets these things in others by their own lives. Perhaps the most effective expression of compassion is sometimes expressed by the simple and pathetic phrase, "I know how it feels." Commiseration in all the pregnant meaning of that word now rests in large part on memory.

Thus we can see why the middle station in life with the wide experience of the ups and downs, of pleasure and pain alike, that is not too protected on the one hand so as to feel exemption from evil and the insolence sometimes thought the opposite of pity; not so absolutely happy as to feel no longer liable to suffering, so that the fear that it may happen to us is removed on the one hand, and on the other hand not so thrust down to the nadir of utter ruin, that nothing more can be suffered, gives the sanest basis for pity.

Thus, too, we can see why it is rare or feeble in the very young. They have been so sheltered and have come so little into contact with the great enemies of man's happiness, that they lack the faculty of appreciating other pain; their imagination is undeveloped in this direction, since it lacks this spur; and they seem selfish because pity is a power that comes to its ripeness only as maturity is approached. The old, on the other hand, have suffered too much and perhaps grown callous and wonted, so that the best age of pity is that when the emotional life is at its strongest and best.

Imagination is another covariant of pity and a momentous agent of altruism generally. A life of sense and plodding, unpoetic practility is introverted and cannot become deeply interested in others' weal or woe. Men differ greatly in the vividness with which they recall their own past sufferings or picture those they fear in the future. *Mitgefühl*, *Mitleid*, *Mitfreude* depend in part upon the vivid depiction of the inner life of others. A lady I know is always ill the next day after her husband's headaches, which she seems to suffer from more keenly than he does, sometimes almost feeling the pain. It is hard for children to imagine the ailments of old age; for both the upper and lower strata of society to imagine each other's joy and sorrows. Plato urged that every physician in order to have a really deep insight into the condition of his patients must have had experiences of illness in his own body. Dr. Howe blindfolded himself for days to more keenly realize the infirmities of the inmates of his institution. Sympathetic punishments occasionally used by teachers like tying up one leg in those who had laughed at the lame, withholding a meal to those who had refused to help the hungry, thrusting pins into those who had tormented animals, blindfolding those who were cruel to the blind, advising a year or month of rough life among the poor for heartless adolescents or for more effective charity work, thereby to quicken that kind of imagination which consists not in visual representation of the images of suffering as in the appreciation of how misfortune feels from within. In those beatific souls, whose whole life is in and for others, whose keenest anguish is vicarious, we always find real power of reproducing alien states. All that quickens the humanistic exercise of this faculty makes for pitifulness.

The legitimate *expression* of pity is some act directed toward the relief of suffering and the subjective easement following objective betterment. Of all our correspondents who tell what they wish to do, only four-seventeenths really do anything where they might act. Many seek diversion by change of occupation or of attention instead of lessening or comforting sorrow.

Others simply sit by, caress, try to comfort, console or express pity; others go off and cry; some do not act because it is hard to do the right thing or to choose between many things or settle the right principle. Modern scientific charity forbids giving doles to beggars directly and thus helps the beggar, although it is doubtful whether thereby it does best for the donor. The first effect of impotence to act is to dam up and intensify pity. The very fact that nothing can be done increases the pathos. Writers of serial novels are implored not to let the heroes or heroines die, sometimes lest the shock prove too much for highly sensitized readers. Spinoza's dispraise of pity was that it was passive, whereas all emotion is motive and should prompt to action. To pity most where insight shows some duty and to act promptly in a way psychologically nearest to that suggested by the incitement is best and is the pedagogic rule.

Aristotle's statement that education largely consisted in *learning to fear aright* or to fear those objects really dangerous in due proportion, the argument that I have elsewhere urged that a good part of moral education might be as teaching us to *be angry aright*, so that indignation be righteously directed, the New Testament doctrine of love that we must set our affections upon heavenly treasures that abide and love only the most worthy of love has its analogue here, so that we can say that to *pity aright* is a very important part of the education of the heart. One of the greatest moral problems is what is the most truly pitiable thing in the world, and most will admit that it is not necessarily the greatest pain as popular sentiment avers. Wherever there is conscious suffering, there the good Samaritan vials of pity are poured out. We may conceive of pity as primordially a sentiment undetermined in any special direction, but as predisposing man to sympathize with suffering wherever met. The environment at any rate largely determines the special forms which it takes in aiding sickness, childhood, poverty etc. As it becomes highly sensitized in one direction it tends to grow obtuse or callous in others. Its direction may be fantastic and absurd. One writer declares she pities most of all in the world those people whose pity is most wrongly directed. Everything indicates thus that pity is plastic, pliable, and therefore educable. Evolution suggests a new answer to the question—what should be the supreme object of pity? It points not to the undervitalized poor, not to the moribund sick, defectives, and criminals, because by aiding them to survive it interferes with the process of wholesome natural selection by which all that is best has hitherto been developed. Pity needs new ideals. Its work is no longer the salvage of the wreckage of humanity, but if Jesus came to our biological age he would be crucified afresh in

the thwarted ambitions and blighted ideals of those most able, yet most often crushed and discouraged by circumstances over which they have no control. Pity, has its highest office then in removing the handicaps from those most able to help man to higher levels—the leaders on more exalted plains who can be of most aid in ushering in the kingdom of the superman. The mission of pity in the world to-day is to minister to the needs of élite youth at the stage of later adolescence when their development is so easily arrested, but at that age when the prolongation of educational incentive and opportunity would give them careers in the upper stories of human endeavor where both need and service are greatest. In struggling genius and talent tingling with pride and sensitiveness in noble ambitions to attain the summits of human endeavor; in these phenomena of altitude and not in the lower levels of opportunity Christ is still crucified, and the most pathetic tragedies are enacted although most removed from common observation. To inspire, to bring the ideals of living always at the top of one's condition, whether diatectically or morally; to add to human euphoria so that the plateau of the best half of the race will be high, so that the summits of human possibility may be easier attained—this is the highest service of pity. Wont and habit are strong and perhaps their function is even more so in the realm of feeling and sentiment than Lamark thought, even though it may not act by heredity, but that there is a strong undertow of tendency in this direction, I have myself not a shadow of doubt.

PSYCHOLOGICAL LITERATURE.

Elementos de Microbiologia para uso de los estudiantes de medicina y veterinaria. Por LUIS DEL RIO Y DE LARA. Madrid, 1899, pp. 645.

The author of this portly volume with its 195 figures in text is Professor of Normal Histology and Pathological Anatomy in the Medical Faculty at Saragossa, and the author of many other papers and essays on biological, medical, and hygienic subjects. He received, moreover, a gold medal from the Ninth International Congress of Hygiene and Demography. The bibliography given at pages 214-218, together with the frequent references in the text to standard names and authorities, proves his control of the literature of the topics with which he deals. The book is intended for medical and veterinary students, and the subjects considered are treated in great detail. Part I (pages 19-220) is devoted to the general technique of microbiology (instruments, culture-mediums, culture-technique, microscopy of microbes, etc.); Part II (pp. 221-380) deals with the microbe in general (morphology, structure, chemistry, physiology, functions, milieu, immunity, etc.); Part III (pp. 381-626) treats of the genuine microbic diseases of man and the domestic animals. Of particular interest to Americans at this time are the accounts of yellow fever and the bubonic plague (pp. 572-578.) Professor del Rio protests against the injustice of those governments that, by a quasi-despisal of veterinary science, create an anti-scientific primogeniture to the advantage of the physician. In microbiology the great importance of the study of animals in relation to the diseases of man is apparent. Altogether this book contains a mass of very useful and interesting scientific information.

ALEX. F. CHAMBERLAIN.

A Study of the Sense Epithets of Shelley and Keats. By MARY GRACE CALDWELL. (Wellesley College Psychological Studies) Poet Lore, X, 1898. pp. 573-579.

By a careful count and tabulation of the sense epithets used by these poets the author is able to bring out several points of interest with regard to them. In Shelley's work about 80% of the epithets are visual, 9% auditory and 8% tactual; in Keats's about 74% are visual, 11% auditory and 10% tactual. Adjectives of taste and smell were also counted, but the proportion is small. There is little reason to imagine that this order of the senses would be changed by a census of other poets and is strong testimony to the general "eye-mindedness" of the literary side of life. Of course many of the terms are used metaphorically, about 43% by Shelley, against 39% by Keats. Per line Keats uses many more sense words than Shelley; in the case of visual words the proportion is about 5 : 3, and in the cases of the other senses decidedly greater. Shelley, however, uses color words with greater frequency; Keats, those for brightness and form. Both poets speak of blue, green, white and gold more frequently than of red. In general the epithets show that "Shelley is the more subjective Keats the more objective of the two poets."

E. C. S.

I Sogni e il Sonno nell' isterismo e nella epilessia. DOTT. SANTE DE SANCTIS, Aiuto alla clinica psichiatrica di Roma. Roma, 1896. pp. 217, sm. 8o.

The author of this little volume is assistant in the Psychiatrical Clinic at Rome, and his motto is found on the last page "First the facts—theories and hypothesis come afterwards." The work consists of an Introduction (pp. 5-46), treating of dreams and mysticism, methods of dream-study,—the author promises himself a book on the dreams of animals, infants, idiots, insane; the semeiological value of dreaming, questions and problems; Part I (pp. 47-114) on Hysterism, with notes of 24 observations, more or less detailed; Part II (pp. 115-160) on Epilepsy, with notes of observation 25-50; Part III (pp. 161-216) Conclusions. The book is remarkably well provided with bibliographical references in the form of foot-notes, from Aristotle and the Bible to Havelock Ellis's *Man and Woman*. In his general conclusions the author gives the results of investigations of 53 cases of grave hysterism, 45 cases of light hysterism, 45 cases of epilepsy of classic sort and 25 old epileptics. Dr. Sante de Sanctis considers that his experiments and observations prove that in hysterism and epilepsy there exists a specific nocturnal syndrome, and in hysterism an oniric stigma.

A. F. C.

The Englishwoman's Year Book and Directory, 1900. Edited by E. JANES. London, A. & C. Black; New York, The Macmillan Co., 1900. pp. xxvi., 340.

Who's Who, 1900. London, A. & C. Black; New York, The Macmillan Co., 1900. pp. xviii, 1092.

These are useful and well-made books, containing a mass of information in compendious and reliable form. The psychologist will be most directly interested in the scientific publications and university privileges of English women, as set forth in the first volume, and in the small part played by psychology in the second. There is, apparently, no chair of psychology in the English universities (p. 106), and Professor Dewey seems to be the only American psychologist to obtain mention.

Le Système Nerveux Central. Structure et Fonctions Histoire Critique des Théories et des Doctrines. JULES SOURY, Paris, 1899. pp. 1863, 27 Figs. in text.

This has the appearance of a monumental work of reference for the history and development of neurology. Hitherto, the student has been compelled to ransack original sources in all manner of ancient and modern languages, many of them difficult or imposible of access, or pick up stray neurological crumbs from various histories of medicine. Now we have it all sifted out in plain French, and with test passages from the Greek, Latin and other original languages, conveniently carried along by means of parentheses in the text.

The scope of the work is indicated by the index of authors where we find that the contributions of about 1900 workers, from Alcmeon of Cotona, 500 years B. C., who discovered the optic nerves and developed the idea of the sensory functions of the brain, often called the first animal anatomist, down to Golgi, His, Flechsig and Cajal, are passed in review. It is further shown, and the two ponderous volumes are made usable, by a complete analytical table arranged by authors and topics of over 70 pages of fine print. Especially full reference is made to ancient and classical writers. For example, Aristotle's views on neurology are given 130 page references, and we are especially indebted to the writer for making Galen available, so far as his works are pre-

served to us. The section on antiquity covers about 330 pages and brings the subject down to and through Galen. Treatment of neurological developments during the middle ages "Moyen Age" occupies but 30 pages. Modern Neurology, "Temps Modernes" is considered to begin with Varolius, Vasalius, Silvius, and others of the sixteenth century, and occupies over 300 pages. Contemporary neurology covers the remaining 1,000 pages. The weak feature of the book is paucity of diagram and illustration which make it compare somewhat unfavorably with modern compendia of neurology, but the book really stands in a class by itself. C. F. HODGE.

A study of the Neurone Theory. By M. F. FISCHER. Journ. of Exp. Med., IV, Nos. 5-6, 1899. pp. 535-540; Plates XXIII and XXIV.

By means of golgi and methylene blue preparations of cortex, basal ganglia and spinal cord in the white rat, and of human spinal cord, the author has demonstrated bridge-like connections between neighboring cells in a fairly large number of cases. The methylene blue specimens enable one to follow the course of the connecting band of protoplasm without danger of being deceived by an artifact.

Regeneration of Nerve Fibres in the Central Nervous System. By W. L. WORCESTER. Journ. of Exp. Med., III, No. 6, 1898. pp. 579-584; Plates LII.

Regeneration of the Dorsal Root Fibres of the Second Cervical Nerve within the Spinal Cord. By W. S. BAER, P. M. DAWSON, and H. T. MARSHALL. Journ. of Exp. Med. IV, No. 1, 1899. pp. 29-46.

Description of the finding of a few isolated fibres within the central nervous system, the origin of which by regeneration can be definitely relied upon.

Le cosi delle degenerazioni retrograde del midollo spinale in rapporto al ristabilarsi funzionale nel dominio dei nervi lesi. C. CENI. Rivista sper. di freniatria, XXV, 1899. pp. 353-365.

Marchi specimens of the spinal cord in dogs in which the sciatic nerve had previously been cut showed degeneration in the cord only in those cases in which there was failure of recovery of function.

On the Destination of the Descending Antero-Lateral Tract in the Spinal Cord. E. A. SCHAFER. Proc. of the Physiol. Soc., May 12, 1899, in the Journ. of Physiol., Vol. XXIV, p. xxxii.

Prof. Schäfer has previously shown fibres of the pyramidal tract ending around and near the cells of Clarke's column. The present communication describes fibres of the descending antero-lateral tract in the monkey ending around the large cells of the anterior horn.

Zur Kenntniss der sensiblen Leitungsbahnenim Rückenmark. LANGENDORFF. Pflüger's Arch., Vol. LXXI, 1898. pp. 401-411.

A series of experiments to show that touch and pain fibres do not pass up directly through the dorsal columns but have cell connections in the immediately related gray matter. In the anæsthetized animal touching any part of the body produces a rise in blood pressure. If, however, the dorsal aorta be ligated, thus destroying the gray matter of the cord below the obstruction no such reflex is obtained from the hinder part of the animal, though the rise of blood pressure occurs exactly as before if the nasal mucous membrane be irritated. The posterior part of the animal is also insensible to pain.

The injection of strychnine causes convulsions of reflex origin. These immediately cease behind the obstruction if the aorta be ligated,

nor can they be produced by strong stimulation of the hinder parts, although aroused by a touch on the anterior limb. The fact that irritation of the posterior limb produces no reflex movements of anterior part of the body or of the fore limb, shows also that the collateral branches of fibres entering low down cannot be of much importance in the upper regions of the cord.

Les centres d'association et les localisations cérébrales chez le chien. J. DEMOOR. Proc. Fourth Inter. Cong. of Physiol., Journ. of Physiol., XXIII, Suppl. p. 8-9, 1899.

There are in the dog centres of projection and of association, the latter being of more importance in the parietal than in the frontal region. Examination of cortical material 8, 9, 10 and 11 months after operation showed no regeneration of cells.

La signification de l'état moniliforme des neurones cérébraux. J. DEMOOR. Proc. Fourth Inter. Cong. of Physiol., Journ. of Physiol., XXIII, Suppl. p. 8, 1899.

In the olfactory neurones both cellulipetal and cellulifugal processes become moniliform under cocaine. The moniliform condition is a species of contraction, the nervous elements being plastic though not necessarily amoeboid. The rupture of the normal relation between neurones may precede the moniliform condition.

L'état moniliforme des neurones chez les invertébrés avec quelques remarques sur les vertébrés. J. HAVET. La Cellule, XVI, pp. 37-46, 1899.

The moniliform condition is very marked in annelids, gastropod mollusks and crustacea after chloroform, ether and morphine; but the writer points out the necessity of considering, in vertebrate material, the modifications naturally occurring after death.

On the Structure of Cell Protoplasm. W. B. HARDY. J. Physiol., XXIV, 1899, pp. 210; Plate III.

Experiments are described demonstrating the action of various reagents on colloid matter, as, for example, mercuric chlorid on gelatin. In this way, various net-works and other artifacts have been obtained which reproduce very exactly many of the appearances which we commonly consider to result from the inherent structure of cell protoplasm.

Ueber die Lage der motorischen Rindencentren des Menschen nach Ergebnissen faradischer Reizung derselben bei Gehirnoperationen. VON BECHTEREW. Du Bois-Reymond's Archiv., 1899; Suppl., pp. 543-546.

Reports three cases of operation in epilepsy with faradisation of the cortical motor areas, in support of the observations of Ferrier and Horsley. The arrangement of the centers in the central convolutions, and in adjacent parts of the frontal lobe, is fully analogous to that found in apes.

Untersuchungsergebnisse betreffend die Erregbarkeit des hinteren Abschnittes des Stirnlappens. VON BECHTEREW. Du Bois-Reymond's Archiv., 1899; Suppl., pp. 500-504.

The author finds, in experiments upon apes, that the frontal cortex contains centers for many movements other than those of the head and eyeballs. Centers for the control of forehead muscles, for the closing of the eyelids, for the ear muscles and for dilation of the

pupil, are described, together with two regions from which increase or inhibition of respiration may be obtained respectively.

C. C. STEWART.

The World and the Individual. JOSIAH ROYCE. Gifford Lectures before the University of Aberdeen, N. Y. The Macmillan Co., 1900.

In this book Prof. Royce considers at length four historic ways of looking at being. The first three he analyzes and discards as either self-contradictory or inadequate, and then sets forth his own view of reality, a form of absolute idealism essentially the same as that reached in his previous treatments of the ontological problem.

The first takes up realism, both in its extreme form and as modified by a partial recognition of the idealistic standpoint; but he concludes that this view in either case cannot stand, since it separates irreparably the idea and its object, thus leaving two unrelated entities. For the second way of looking at reality, namely from the standpoint of mysticism, Prof. Royce has more sympathy, since this view "is from the outset reflective and founded on an appeal to experience." It is, however, by simply denying the finite that mysticism reaches the infinite, and like realism this second way of defining being is an abstraction and must be discarded. The third conception of being is set forth by critical rationalism, which defines reality as validity, truth, the standard of ideas. This conception Prof. Royce considers essentially true, but still inadequate, since it insists on too great a separation between the idea and its object. To bridge over this separation Prof. Royce advances his own point of view.

"Idea and object are related," he says, "because the object does not transcend the idea, and always in the last analysis is idea." More specifically the relation rests in the fact that the idea wills its object, and 'the will in question is the will that the ideas embodies.' It is not the mere individual will and idea, however, that gives to us reality, since we know that individual wills are often opposed and that individual ideas are sometimes false. Final truth and final being are found in the absolute, whose existence is certain, since truth is certain. Prof. Royce answers the objection that experience is the only test for truth by saying that he perfectly agrees with this proposition, but he then defines experience in purely ideal terms, thus leaving here no basis for a realistic philosophy.

In asking the question, has Prof. Royce satisfactorily established his contention as to the nature of ultimate reality, it may be proper to consider whether he is justified in asserting that realism separates completely the idea and its object. Might not the realist reply to this objection that the true idea and its object are connected by the law of causality, the most real and fundamental of all relations? Further, is the assumption that Prof. Royce makes that we can never transcend the idea capable of proof. It is true that any statement concerning the idea or its object must be in ideal terms; but does it follow from this that the object is thus of necessity ideal. And finally, in bringing the conception of the will into his philosophy has not Prof. Royce gone beyond pure idealism? Can the will be completely explained from an ideational standpoint? does it not transcend even consciousness, and is not here a realistic basis to Prof. Royce's idealism?

S. S. COLVIN.

BOOK NOTES.

G. S. H.

What is Thought? or the Problem of Philosophy by Way of a General Conclusion so far, by JAMES H. STIRLING. T. and T. Clark, Edinburgh, 1900. pp. 423. Price, 10s. 6d.

It is a great delight after all these years to hear again from the brilliant author of "The Secret of Hegel" on his favorite themes. Schelling, and still more Kant, occupy a larger place in his mind than before, but his mastery of German idealistic systems, his familiarity with the lives, characters, and letters of the great thinkers who represented it, and of the modern currents which have sprung from them, make his pages fresh and perhaps as easy reading on deep subjects as one can readily find.

Evolution by Atrophy in Biology and Sociology, by JEAN DEMOOR, JEAN MASSART and ÉMILE VANDERVELDE. Translated by Mrs. Chalmers Mitchell. D. Appleton and Co., New York, 1899. pp. 322.

This volume is a good type of joint authorship. The points best brought out are first the universality of degenerative evolution in plants, animals, and society. The pathology of degenerative evolution, so often the reversal of evolution, is next discussed. In general a rudimentary organ cannot reassume its primitive function. The causes of degeneration and atrophy are finally taken up and discussed quite fully for society and for animals.

Wörterbuch der Philosophischen Begriffe und Ausdrücke, von RUDOLF EISLER. E. S. Mittler und Sohn, Berlin, 1899. pp. 956.

This is not only an extremely convenient, but ought to be a quite indispensable book for every philosophical library. It is wrought out from the sources, and on all important points abounds in quotations.

The Grammar of Science, by KARL PEARSON. Adam and Charles Black, London, 1900. pp. 548.

This London Professor of Mathematics and Mechanics here prints a very greatly enlarged second edition eight years after the first was published. The work deals essentially with the fundamental concepts of science, especially those of force and matter, cause and effect, space, time, motion, life, evolution, and the classification of the sciences. Its standpoint is as unique among English physicists as that of Mach, whom the author's views in some respects resemble, among his German colleagues.

Clinical Studies in Vice and Insanity, by GEORGE R. WILSON. William F. Clay, Edinburgh, and the Macmillan Co., New York, 1899. pp. 234.

The author of this book, favorably known by his work on drunkenness in the Social Science Series, bases it upon careful clinical studies and records made at Mavisbank. It treats of fifteen cases of insanity and twelve of alcoholism. The cases are typical, interesting, and carefully studied.

Die Energetik nach ihrer geschichtlichen Entwickelung, von GEORG HELM. Veit und Comp, Leipzig, 1898. pp. 370.

This professor in the Dresden Technical Institute has written here a work largely polemic in proof of his assertion that energetique is a unitary development of thought, a knowledge of a peculiar kind embracing all nature. The general conception of energy is traced from Heraclitus to Robert Mayer, thence to Grove, Joule and Helmholtz. A second stage is represented by Carnot, Clapeyron, Boltzmann and Thomson. Thermodynamics began with Clausius. The third part characterizes the doubters of thermodynamic principle, which has mathematical difficulties. The fourth shows these doctrines applied to chemistry from Kirchhoff to Gibbs and Planck. The next the transforming effect of this doctrine in mechanics. Then follow the factors and tendencies.

La Constitution Du Monde. Dynamique des Atomes. Nouveaux Principes de Philosophie Naturelle, par CLÉMENCE ROYER. Schleicher Frères, Paris, 1900. pp. 799.

This ponderous volume, with ninety-two curious figures and four large folded plates, is an attempt to base a new system of natural philosophy upon atomic dynamism. Beginning with the evolution of the modern ideas of matter and of atoms, the second part considers vibratory phenomena, heat, light, sound, etc. Solids, liquids, gases, vital processes, weight, gravity, seas, and the evolution of worlds, each constitute successive chapters respectively. The boldness of views here presented is apparent in the very cuts, which show us how the atoms in a molecule of water, carbonic acid, potassium, etc., are arranged, while other cuts are explanatory of the forces. A colored chart gives the spectral colors as they pass through the ether. The figures illustrating the action of the forces are extremely complex, and, perhaps, few bolder books have ever been written.

Essai Critique sur L'Hypothèse des Atomes dans la Science Contemporaine, par ARTHUR HANNEQUIN. F. Alcan, Paris, 1899. pp. 457.

The author is a professor in the Lyon Faculty of Letters, and discusses the relations of atoms to geometry and mechanism, atomism in nature, being, appearance, and the future. Atoms, however, must not be regarded as absolute or eternal.

Ethics: An Introductory Manual for the Use of University Students. George Bell and Sons, London, 1898. pp. 220. Price, 3s. 6d.

Beginning with the scope and method of ethics, the author discusses good, happiness, perfection, right, obligation, duty, intuitional and hedonistic theories, the psychology of ethics, its relations to law, theology, the history of ethical theories in England, and classification of moral excellencies.

Chalk Lines over Morals, by CHARLES CAVERNO. Charles H. Kerr and Co., 1898. pp. 313.

These are twelve "progressive conservative" lectures, which some would call radical, delivered several years ago in Chicago, and here reprinted. Morals are discussed with relation to God, the Bible, Christ, Holy Spirit, immortality, miracle, spiritism, politics, divorce, capital, labor.

Introduction to Ethics, by FRANK THILLY. Charles Scribner's Sons, New York, 1900. pp. 346.

Professor Thilly very properly dedicates his book to Professor Paulsen. He discusses the nature and methods of ethics, theories of conscience, its analysis and explanation, the ultimate grounds of moral distinctions, the teleological view, theories of the highest good,

hedonism and energism, optimism versus pessimism, character and freedom.

The Making of Character: Some Educational Aspects of Ethics, by JOHN MACCUNN. The Macmillan Co., New York, 1900. pp. 226. Price, $1.25.

Mr. MacCunn's volume is distinctly new and grows upon the mind by acquaintance. The first part discusses congenital endowments, heredity, temperament, repression, and habit. The next deals with educative influences, health, nature, family, school, friendship, citizenship, etc. The third considers judgment and ideals, and the last, self development and self control.

Bushido, the Soul of Japan, by INAZO NITOBÉ. The Leeds and Biddle Co., Philadelphia, 1900. pp. 127.

Bushido is an ethical system in Japan which teaches rectitude, justice, courage, sympathy, politeness, truth, honor, self control, the position of woman, and is taught very extensively in the indigenous schools. The writer conceives it, as the title indicates, as the ethical heart of his country. It is no set doctrine or system, but lives in lives and by the method of personal inculcation.

L'Origine de la Pensée et de la Parole, par M. MONCALM. F. Alcan, Paris, 1900. pp. 316.

The author describes the time of our Aryan ancestors, the language of animals and primitive men from the standpoint of the philosophy of language, the history of ancient speech, myths, the Vedic hymns, religion, etc., in an interesting and entertaining way. The author is a disciple of Max Müller.

The Criminal: His Personnel and Environment, by AUGUST DRÄHMS. The Macmillan Co., New York, 1900. pp. 402.

In this admirable summary the philosophy of crime, its historic outline, and the type, modes of identification and classification of criminals, are first considered. The instinctive is sharply differentiated from the habitual criminal. The demography of crime, its relation to hypnotism, juvenile offenders, punishment, reform and prevention, are discussed, and a well chosen four page list of authorities in English upon the subject with a copious index conclude the volume.

Race and Religion. Hellenistic Theology: Its Place in Christian Thought, by THOMAS ALLIN. James Clarke and Co., London, 1899. pp. 161.

Hellenism, Semitism and Latinism are here concisely characterized to show that the Greek mind mediates between the other types, and that in ancient times God was conceived as the parent source iminent in the universe and the incarnation, as the climax of eternal purpose, and not as an expedient to remedy a marred plan.

A First Book in Organic Evolution, by D. KERFOOT SHUTE. The Open Court Publishing Co., Chicago, 1899. pp. 285.

This evolutionary primer begins with an account of cells, considers heredity, unstable environment through the geologic periods, with the transmutation of living forms, natural selection, human evolution, classification of plants and animals, with reference glossary index, twenty-seven illustrations and ten colored plates. The form of the book is attractive and the work seems admirably done.

L'Année Philosophique. F. PILLON. Dixieme Anèe, 1899. F. Alcan, Paris, 1900. pp. 315.

Besides F. Pillon's philosophical bibliography for 1898, this num-

ber contains articles by Renouvier on personality, Hamelin on induction, Pillon on the evolution of idealism to the eighteenth century, and Dauriac on the method and doctrine of Shadworth Hodgson.

Die Analyse der Empfindungen und das Verhältniss des Physischen zum Psychischen, von E. MACH. G. Fischer, Jena, 1900. 2 Auflage. pp. 244.

This genial and venerable physicist, formerly of Prague now of Vienna, here reprints with additions which more than double its size a treatise, which first appeared in 1885, and which is dedicated very appropriately to Prof. Karl Pearson, of London, whose chair and the direction of whose work is almost the English analogue of Prof. Mach's.

La Tristesse et La Joie, par GEORGES DUMAS. F. Alcan, Paris, 1900. pp. 426.

After taking account of his method and object and stating some general ideas about pleasure and pain, the writer takes up with more detail passive and then active sadness, morbid joy, their original mechanism, their psycho-physiology, psycho-chemistry, psycho-physics, psycho-dynamics, and in the ninth chapter their nature. The work is mainly compilatory and speculative, but the writer has attempted a few records of pulse, respiration, temperature and weight in exalted and depressed states made in the psychic clinic of Joffroy, which is dedicated to Ribot.

The Spiritual Life: Studies in the Science of Religion, by GEORGE A. COE. Eaton and Mains, New York; Curtis and Jennings, Cincinnati, 1900. pp. 279.

This writer describes the psychological point of view; makes a study of religious awakening, of some adolescent difficulties of religious dynamics, divine healing, and spirituality; prints an elaborate questionnaire inviting further facts in the appendix; and lays much stress upon Starbuck's work. Like Starbuck's book this is important and significant as opening a new field, but like it, too, is immature and tentative. The author seems to recognize this in some measure and on the whole we ought to be grateful to him that in this time of remarkable interest in the subject, and when its practical influence is sure to be great, he has no longer delayed the presentation of such results as he has secured, as well as that he is more concise than Starbuck.

Memory: An Inductive Study, by FREDERICK W. COLEGROVE. Henry Holt and Co., New York, 1900. pp. 367.

This work is the result of two years' study by a fellow at Clark University and is preceded by an introduction by G. Stanley Hall. The chapters are entitled—historical orientation, biological orientation, diseases of the memory, brain and mind, memories, individual memories, apperception and association, and pedagogical applications. A good bibliography and index are appended and the type, paper, cover and general form of the book are among the most attractive ever seen in this field. As a whole the work shows great industry, wide reading, is clearly presented, and contains thirty-eight cuts with four full page illustrations from Flechsig and others illustrating brain localization. The author attempts not only compilation but presents in the chapter on individual memories the results of a long and labored special questionnaire study, supplemented by many facts gathered from personal study of memory in old age and in some of its morbid forms.

BOOKS RECEIVED.

L'Année Philosophique. Publiée sons la direction de F. Pillon. Dixième année, 1899. Félix Alcan, Paris, 1900. pp. 315. Price, Fcs. 5.

BERGSON, HENRI. Le rire. Essai sur la signification du comique. Félix Alcan, Paris, 1900. pp. 204. Price, Fcs. 2.50.

BRUNSCHVICG, LÉON. Introduction a la vie de l'esprit. Félix Alcan, Paris, 1900. pp. 176. Price, Fcs. 2.50.

DUMAS, GEORGES. La tristesse et la joie. Félix Alcan, Paris, 1900. pp. 426. Price, Fcs. 7.50.

FÉRÉ, CH. Sensation et movement. Etudes expérimentales de psychomécanique. Deuxieme édition. Félix Alcan, Paris, 1900. pp. 170. Price, Fcs. 2.50.

FLEURY, MAURICE DE. Medicine and the mind (La médecine de l'esprit.) Translated by Stacy B. Collins, M. D. (Downey & Co., London, 1900.) Charles Scribner's Sons, N. Y. pp. 373. Price, $4.50.

JACOBI, ABRAHAM. "Festschrift" in honor of Abraham Jacobi, M. D., LL. D., to commemorate the seventieth anniversary of his birth. G. P. Putnam's Sons, N. Y., 1900. pp. 496.

NEWCOMB, CHARLES B. Discovery of a lost trail. Lee & Shepard, Boston, 1900. pp. 282. Price, $1.50.

PIAT, CLODIUS. Socrate (*Les Grands Philosophes.*) Félix Alcan, Paris, 1900. pp. 270. Price, 5 Fcs.

RUYSSEN, THÉODORE. Kant. (*Les Grands Philosophes.*) Félix Alcan, Paris, 1900. pp. 391.

INDEX.

ORIGINAL ARTICLES.

SUBJECT INDEX.

NAMES OF AUTHORS.

(The names of those who have contributed original matter are printed in SMALL CAPITALS.)

The American journal of psychology