No really satisfactory definition of attention seems available at the present time, although textbooks in educational psychology consider it as "the focusing of consciousness" while giving little or no explanation of the way in which such focusing is done or what is meant by consciousness.

Although various theories have been advanced from time to time, and tests have been devised to discover the nature of attention and the means of controlling and using it to the best advantage, it still remains a more or less intangible concept.

The purpose of this thesis is the examination of material which has been written—largely in the last two decades—on attention in order to discover the content and to estimate its worth, to the writer at least, as shown by its inclusion or exclusion from the thesis, in the hope that more definite and pertinent ideas may be made available; that some reconciliation of conflicting ideas may be brought about; and possibly some additions made to incomplete ideas.

The procedure followed in the research for material makes available in the resultant bibliography a summary of the material on attention for the last two decades for the use of future students.

The study is limited in that the selection and synthesis of the material was done by one person only and that, in the case of material from foreign literature, only abstracts were available—some of them very brief.

A general review of the literature and history of attention, covering definitions of the subject and its relations to other psychological phenomena, has been presented. Notably ingenious devices and methods were found to have been used in the study of attention. These devices, the measurements obtained, and the interpretations of those measurements, however, are not believed ingenious enough to isolate the entity or psychological factor of attention clearly and indisputably, perhaps due to confusion of theory and definition or to inadequacy of experimental devices and interpretation.
Various theories have been presented as to the relation of attention to intelligence; to age and maturation and the changes involved therein; to introversion and extroversion; differences between visual and auditory attention; and the differences in degrees of attention among dependent, defective (mentally or physically), and predelinquent children. Comparisons between directed and undirected attention have also been covered.

The physical adjustments necessary in bringing about concentrated attention as well as the physical effects of concentrated attention and of distraction of the attention have been reviewed to some extent also. The effects of the various sense organs upon concentration of attention, and vice versa, have been examined; and, finally, various investigations with regard to attention as it is affected under abnormal conditions such as fatigue, emotion, psychoneurosis and other abnormal mental states, and the influence of alcohol and benzedrine, have been outlined although very little conclusive evidence has seemed to be available.

No claim as to the infallibility of these findings is made. It is conceded that a great deal of further investigation can still be profitably made in all of the various fields touched upon in this thesis. None of the material presented seems to have quite arrived at the core of attention, just what it is, or the complete way in which it operates psychologically and physiologically. It is hoped, however, that by using the sources of material made available in this thesis, the way may be pointed to further investigations into the various aspects of attention as reviewed here in order to establish more complete data and a better understanding of its phenomena, with a view to practical application in all walks of life.
ATTENTION AS A SUBJECT OF STUDY
IN EDUCATIONAL PSYCHOLOGY

by
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ATTENTION AS A SUBJECT OF STUDY
IN EDUCATIONAL PSYCHOLOGY

CHAPTER I
INTRODUCTION

There is, at the present time, no satisfactory definition of attention. The usual definition given in textbooks in educational psychology is that "attention is the focusing of consciousness," but little or no explanation is given of the way in which the focusing is done or of the meaning of consciousness.

Hundreds of thousands of words have been written in psychology textbooks and magazine articles about or around attention in the fields of general psychology, educational psychology, and psychology as applied to business—especially merchandise display and advertising. Hundreds of thousands of parents have told their children, and tens of thousands of teachers have told their pupils to "pay attention to what you are doing" without knowing, except in the vaguest general way, what they meant by what they said. More hundreds of thousands of people, young and old, have wished that they had "better powers of concentration," meaning "concentrated attention," without knowing what they meant by the term, or the way to proceed in getting it, and
too often, leaving the whole business in the wishful state.

The development of prolonged or sustained attention is not easy. It is not a matter of accident that the class periods in the first grades of the elementary schools are ten minutes in length for the so-called "solid subjects" and fifty minutes in length at the college level. The little folk, could not, under any circumstances, give their attentions to the printed page for longer consecutive periods of time. Many college students do not do much better, although some go far beyond the allotted fifty minutes in their own study periods. The factors of monotonity, physical restraint, eye-fatigue, and many others affect the duration of attention at all levels and under all conditions—inside of schools and out. These, like attention itself, are subject to the influences of training.

The purpose of this thesis is the examination of the material which has been written—largely in the last two decades—on the subject of attention, in order to discover the content and to estimate the worth of this material, to the writer at least, as shown by its inclusion or exclusion from the thesis. It is hoped that more definite and pertinent ideas may be made available to students of educational psychology as a result; that some reconciliation of conflicting ideas may be brought about; and that, possibly,
some additions may be made to incomplete ideas in order to make them more complete.

In the preparation of this thesis, the Psychological Abstracts and the Educational Index were first searched for titles of articles which seemed germane to this study. Other titles and references were collected from the bibliographies contained in the books and the magazine articles as they were read; and these were, in turn, read and abstracts made of the material which was believed to be of value or of interest. Approximately 10 books and 350 magazine articles were read; but nothing was abstracted from many of them because the material was either a duplication of material read frequently before, or was held to be of little value. This procedure will make available a summary of the material of the last two decades, or more, on the subject of attention without the reading of the vast amounts which have been written about it. A limitation of the study is the selection and synthesis of this material by one person only, and that person one who was not unusually well read on this subject before the beginning of this study.
CHAPTER II
THE LITERATURE OF ATTENTION

Definitions of Attention: Kinds: Degrees

Attention is usually defined as "the focusing of consciousness" or the focusing of mental activity, (Woodworth, 207, p. 269). Both Woodworth (207, p. 245) and Starch (179, p. 245) regarded attention, or the ability to attend, as a part of one's native endowment. Starch (179, p. 12-13) wrote: "The energizing power of instinct makes itself felt largely through its control of the attention processes." James (101, p. 404, Vol. 1) described attention as the "focalization, concentration, of consciousness," and treated attention as part of one's native equipment. He wrote: "Everyone knows what attention is .... the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. (Attention) implies withdrawal from some things in order to deal effectively with others. (It is) the opposite of the confused, dazed, scatterbrained state which in French is called distraction."

Thorndike (189, p. 46, Vol. 1) likewise treated attention as a part of one's native equipment. He wrote: "Of the situations to which man is sensitive, some originally excite the further responses--of disposing him, especially
his sense organs and central nervous system, to be more emphatically impressed thereby ......." James (101, p. 403) wrote: "These writers (the empiricists) have utterly ignored the fact that subjective interest, may, by laying its weighty finger on particular items of experience, so accent them as to give least frequent associations far more power to shape our thought than most frequent ones possess. The interest itself, though its genesis is doubtless perfectly natural, makes experience more than it is made by it." All of these writers regarded attention as closely related to interest, although they are no more clear about what interest is than they are about what attention is.

Three kinds or degrees of attention are usually differentiated (179, p. 13-14) (207, p. 258-259) (209, p. 657-658). These are:

a) involuntary or passive;
b) voluntary or active; and
c) nonvoluntary or secondary passive.

Involuntary attention is usually described as comparatively short in duration, comparatively effortless, and given to sudden, extreme, or certain natural stimuli which seem to have almost universal appeal; for example, the sound of the wind in trees--especially evergreen trees--the purling of the water in small streams, and the sounds of gentle waves on the ocean beaches. Involuntary attention
is the attention which was most useful to primitive man, but is still useful in traffic, or to people who lead adventurous lives. About involuntary attention, James (101, p. 416) wrote that the stimulus is usually a sense impression, either very intense, voluminous, or sudden—no matter whether sight, sound, smell, blow, or inner pain—or else it is an instinctive stimulus, a perception which by reason of its nature rather than its mere force appeals to some one of our normal congenital impulses and has a directly exciting quality.

Voluntary attention is comparatively short, but is effortful. It requires effort of the will to bring it about and to sustain it over a period of time. It is the attention given by young children and other uneducated or untrained people, and by other people, to the performance of tasks in which they are not interested. Voluntary attention is usually given for some reward outside of the activity itself. It is only through voluntary attention, however, that one can attain nonvoluntary attention. About voluntary attention, James (101, p. 416) wrote that it is always derived. In voluntary attention, we never make an effort to attend to an object except for the sake of some remote interest which the effort will serve. Both sensorial (peripheral) and intellectual (central) attention may be voluntary.
Nonvoluntary attention is comparatively long and comparatively effortless and is given by reason of training and of interest in the task at hand. For the highly trained or the well educated person, it is the most profitable kind of attention because it means sustained production beyond that possible from the other two kinds of attention.

Whether these three attentions are kinds of attention or are degrees of one kind of attention was debated at some length in the early days of psychology when it was becoming a separate subject of study. This is no longer considered important, especially as there are no satisfactory present means of measuring any of them, and as they merge one into another without any sharp lines of demarcation. In addition, the individual fluctuates from one of these to another according to the exigencies of the moment and to various affecting factors in the environment around him; for example, the difficulty of the material being studied or otherwise worked upon, one's familiarity with the material, boredom with the task either for the moment or over a long period of time, and the lesser factors of humidity, temperature, health, and personal and emotional influences in one's background.
Space Given to the Subject in Textbooks

After these elementary definitions have been stated, and before one proceeds to the more elaborate definitions and qualifications of the subject, it might be of some interest to compare the amounts of space given to the subject of attention in the typical older textbooks on psychology and in the typical newer ones.

Paschal (145, p. 384), reviewing trends in attention theory, wrote: "More than thirty years ago, Tichener declared the doctrine of attention to be one of the three fundamental issues upon which any system of psychology must be based. Modern psychologies are far from being in agreement with this statement, as in none of them has it been a crucial problem. In fact, most of them have ignored it, or have merely paused to pay their respects—or disrespects—in passing. The ebb of the influence of attention can be seen in the fact that in the past two decades many textbooks have omitted all reference to it. The biennial reviews of its literature in the Psychological Bulletin ceased ten years ago. But despite the criticisms that have been aimed at it, the attempts to read it out of the party, attention has had a heartiness that has enabled it to survive. Recently it has entered upon another phase of its cycle, a renewal of interest in its possibilities being in evidence."
D'Agostine (44, p. 101-121) called attention to the material on attention in the writings of the Greek and Roman authors in referring to various phenomena in the field of attention.

Woodworth's *Psychology* (207), published in 1921, was for several years the most widely used college textbook in this field. In this book, twenty-nine pages were given to attention. Starch's *Educational Psychology* (179), published in 1922, was also very widely used in its field for a decade or more. In this book, only five pages were devoted directly to attention, but its relations to other psychological activities are numerous but scattered throughout the text inextricably inseparable from other subjects. In Thorndike's three-volume work, *Educational Psychology* (189), published in 1921, fifty-two pages were directly devoted to attention. William James' two-volume *Principles of Psychology* (101, p. 402-458), published in 1890, contained a chapter consisting of fifty-seven pages devoted to this subject, plus many incidental references in connection with other mental phenomena. On the other hand, Sandiford's *Educational Psychology* (160), a more advanced textbook than Starch's, and published in 1928, made no separate mention of attention.

In the newer books, or those published since 1930--according to the arbitrary selection of this writer--
Crow and Crow (43), in their Educational Psychology, published in 1948, gave three pages to attention. Skinner in his Educational Psychology (175), published in 1949, gave four pages to attention. Hartley, Birch, and Hartley (89), in their Outside Readings in Psychology, published in 1950, gave eighteen pages out of 352 to attention.

Various Divisions and Concepts of the Subject

The students of attention have chosen to divide attention and its study into (a) the range of attention, (b) the span of attention, (c) the duration of attention, and (d) the concentration or the distribution of attention, in attempts to analyze it and seek its essential qualities, according to Wolf (209, p. 657-658). They have not, however, related these to the kinds or degrees of attention. The range of attention is the width of attention from day to day, or the general number of things to which the individual pays attention; i.e., some persons give their attentions to many objects and ideas, others to only a few. The range of attention might, with almost equal validity, be called the range of interests. It is obvious that some individuals have wide ranges of attention. They give attention to many things, not only immediately around them but in their thinking. They may give much or little to each of these, or attend to them in varying amounts, but
all-in-all they give a great deal of attention. Other people have a few interests only, to which some will give large amounts of attention and others will give only small amounts of attention to the few things in which they are interested.

The span of attention is the number of objects, discrete or grouped, to which one can attend in a short fraction of time—usually a tenth or a twentieth of a second. The number varies from one, in concentrated attention, to as many as forty-two, if they are similar and are grouped. The usual experimental device used in this connection is the tachistoscope.

The duration of attention is just what the term implies. It is the length of time during which one can give attention to either a single object, numerous related objects or those in a group, or a whole field of ideas. It is implied, usually, that the kind of attention is non-voluntary and the degree is one of considerable concentration although there is no reason why the duration of involuntary and voluntary attentions should not be measured. Reynax (154, p. 70) goes so far as to state that "genius is only the product of sustained attention which is crystallized around one ideal and a central inspired idea." While Reynax's statement exaggerates and oversimplifies the importance of sustained nonvoluntary attention, it is
nevertheless, based on fact.

The concentration of attention, in contrast with distributed attention, has received relatively little scientific attention. The casual diffusion of attention, as different from positively distributed attention and concentrated attention, has received no attention from writers in this field.

The foregoing has been quite an elementary series of statements about attention. Some additional definitions follow: Pieron (150) wrote, in an elaborate study of attention in 1931, that attention may be considered an expression of the functional unity of the coordination of behavior; that is, it is the result of neural activity and is a part of the native endowment. He stated further that the different levels of attention are related to the complexity of the nerve patterns involved as well as to the dynamogenic and inhibitory activities of other, but influencing, nerve patterns and whatever muscular and glandular activities they may have aroused, and which, in turn, influence the direction and the intensity of the attention. Rodrigua (157, p. 86) wrote that "to be attentive is to be able to discipline active curiosity (one of the commonly listed instincts) by the use of imagination curbed and directed by reason."

Sollier and Drabs (177, p. 18-39) state that what have
been called forms of attention are only "special ways of paying attention" and that these are essentially individual and constitutional and therefore not very susceptible to improvement. It should be observed, however, that the weight of evidence from the psychology laboratories and classes in methods of study disprove their position on the improvability of attention. They (177, p. 18-39) divide the ways of paying attention, as found in professional work and more especially in industrial work, into (a) vigilant attention and (b) selective attention. "Vigilant attention" is the more or less automatic attention, or the apparent lack of attention, given to work or to a machine with which one has been long familiar, and which manifests itself only at any irregularity in either work or machine. "Selective attention," they state, is the specialized attention which persists to the point of attainment of certain goals; for example, the hour of waking, or the times at which a nurse administers medicine. These authors further state that consciousness is an integral part of attention, and that "vigilant" and "selective" really apply to the stimulating causes and not to the process of attention. Their point of view is interesting, very limited in its definition of attention, and--in the view of this writer--incorrect in its belief that the "vigilant" and "selective" processes are more parts of the stimulating causes than of the
process of attention.

Dwelshauvers (51, p. 141-158), after giving the history of what philosophers have included under the name of "attention," has stated that there are numerous forms of adaptation, or "attentions," and not one function which can be called attention. He describes, rather than defines, attentions as practical means which are well adapted to and which bring into one conformation the object and the mind of the person who is doing the thinking and acting.

Stirparo (181, p. 65-68) has taken a philosophical approach, and holds attention to be a part of or the whole of "intensity" in any form of psychic life; thus, attention is a part of all forms of psychic life. To the writer of this thesis, this would appear to be correct in those incidents in which attention increases awareness of an object or idea, and appears to be incorrect in those incidents in which objects or ideas force themselves into attention, especially with emotion-arousing connotations or extreme stimulation of the sense organs.

Johnson (102, p. 601-614) wrote, in 1925, what is about as true today: "Contemporary psychologists make use of a single term, 'attention,' to designate two variables indifferently. One of these variables is the degree of consciousness or the clearness of content; the other is the degree of the sensori-motor adjustment of the organism with
respect to a particular stimulus. Some authors appear to confuse the two concepts, others to regard them as distinct and mutually supplementary." Johnson also pointed out that, in daily life, the two are reciprocal.

James (101, p. 434) wrote much this same material in 1890. He pointed out that the attentive process consists of two physiological processes: the accommodation or adjustment of the sensory organs, and the anticipatory preparation from within of the ideational centers concerned with the object to which the attention is paid. "The sense organs and the bodily muscles which favor (the stimulus) are adjusted most energetically in sensorial (peripheral) attention, whether immediate and reflex, or derived. There are good grounds for believing that even intellectual attention, attention to the idea of a sensible object, is also accompanied with some degree of excitement of the sense organ to which the object appeals. The two processes of sensorial adjustment and ideational preparation probably coexist in all our concrete attentive acts."

Wallon (200, p. 8-15) did not use the word "attention" since he considered it ambiguous, connoting two very dissimilar groups of facts: (a) the actual content of thought, including the whole of the material presented as it appeared in consciousness; and (b) the act of attention and its dynamic conditions. Wallon preferred to use the
term "inattention," by which he meant the various forms of activity into which attention can be analyzed and which compose the concrete and practical experiences with which educators are concerned. He believed that nearly all of the causes leading to inattention are correlated with motor disorders, but this view is not supportable from laboratory experiments or from the experiences of daily life.

Sengupta (169, p. 157-167) preferred to discard much or all of the work done previously on attention and to define it as a state of perseverance in the process of organic adjustment—peripheral and central—which secures the perseveration of experiences. He maintained that such factors in attention experience as emotional tone, primacy, repetition, and intensity, which determine the persistence of experience serve also to induce attention (a word which he had earlier condemned). He also maintained that the definition of attention in terms of what happens in the total field of consciousness which is subjected to attention is untenable because it fails to reveal the essential features of attention. He quarreled with the definition of intensity as a factor in attention because "it is incompatible with the facts," but the importance of intensity in a stimulus and of intensity in the energy with which a stimulus is anticipated and seized upon are both widely accepted as easily defensible. He likewise quarreled with
the factor of clearness as part of attention because it bears no specific correlation with the stimulus and peripheral physiological conditions and because the concept is not sufficiently well-formulated to serve the needs of a theory of attention. It seems to this writer that Sengupta's paper is at best a study in semantics and at worst a piece of sheer verbalism.

In a more constructive paper than Sengupta's (169), Chapman (39, p. 156-165) pointed out that "the greatest obstacle which the student of attention meets is not that of technique but one of a choice between the doctrine of (a) peripheral stimulation and clearness or (b) cognitive clearness or that which occurs within the central nervous system." Chapman, it appears to this writer, fell into the serious error of maintaining that a choice must be made between these two. He chose to defend the cognitive side of attention as the whole of attention and dismissed the peripheral phase of attention as "an independently variable, intensive dimension of experience.....so primitive as to be otherwise indefinable." He (39) "defined" cognitive clearness, on the other hand, as simply "clearness," but borrowed from an earlier writer the following: "We may characterize clearness (in our sense of cognitive clearness) as determinateness or adequacy of experience in respect of agreed-upon properties, and measurable by the
reportability of such properties." He further proposed that "the study of attention would profit largely if we were to state the phenomenon of attention in terms of cognitive clearness"; and warned that "we should see that in Spearman's suggestion of a 'constancy of cognitive output' there is a broad hint toward a theory of range; we should be able to avoid the confusing and superfluous trichotomizing of the problem of range into ranges of 'attention,' 'cognition,' and 'apprehension,'--a process which imposes an unnecessary and idle complication of terminology upon what deserves to be an orderly, intact field of investigation." While Chapman (39, p. 156-165) stated that, following the inclusion of the peripheral phase as a part of attention, "More than twenty years of opportunity for research since the firm establishment of the doctrine have produced almost no new knowledge about attention-qua-attensity (peripheral phase) beyond the laws originally stated by Titchener," the same charge is just as true of the cognitive clearness phase and for a longer period of time. It seems to this writer, that Chapman was more concerned with his attack on the "structuralism" in psychology than with an all-out study of attention, and that he was as guilty of verbalism as many of the other writers on this subject.
HISTORY OF ATTENTION

Wheeler, in a thorough historical and theoretical study of attention in 1928 (202, p. 1-18), surveyed the subject and the terms used over the centuries by the proponents of various schools and summarized the more recent material on this problem as follows: "Now that subjectivism and its parent, dualism, have been superceded in psychological theory by viewpoints which disregard the conscious aspect of behavior, as such, it is to be expected that principles definitely tied up with psychology as the science of consciousness should be regarded with suspicion. The behaviorists have been denying association explicitly but not implicitly. The configurational writers, like the introspectionists, have abandoned association as an explanatory principle. However, there seems distinctly to be a difference in the degree to which the two latter groups seriously accept association from a systematic viewpoint.

.....Sensory and imaginal processes, we are told, derive context from 'situations' and 'situations' are (1) stimuli which the organism selects, unifies, and focalizes, and (2) meaningful experiences of conscious presents, i.e., the unified, organized mental processes in terms of which the organism is aware of the stimulus situation or responds to it," that is, attention. "Then, later we learn there are
as many modes or forms of association as there are ways of being together within a conscious present."

"On the other hand, the configurationists retain association (attention) as a fact but seemingly neglect it, or reveal prejudice against it, as a problem.... First, they would consider parts only in their relation to the whole, not in their relation to each other.... Second, association evolved in a psychological system which abstracted consciousness from the activities of the organism as a whole; i.e., the system was dualistic.... Third, the shift from direct to functional analysis quite naturally turns one's attention away from the thing he is dealing with to its cause."

Wheeler (202) wrote that the different attitudes taken toward association by the configurationists and introspectionists are inconsistent in that: "(1) We are constantly hearing about 'parts,' 'members,' 'factors,' in a configuration, 'membership character' and the like in the Gestalt literature. Descriptive units (not elements) are evidently necessary.... We thus return to the temporal and spatial relations of stimulus details with which the old law of association was concerned. While the problem need not be handled as the associationists handled it, atomistically, as long as the configurations do change little by little, as long as we have to deal with phenomena of differentiation
and growth, integration and disintegration, with definite changes in environment producing definite modifications of behavior, there still remains the problem of association or interrelationship of structures"; that is, the selective function of attention.

"Association and attention depict those unique characteristics of unity in behavior and mental life when terms like integration, interaction, pattern reaction, and the like, are too general."

".....While the concepts of attention and association may have been wrongly applied at times and overdone, they did satisfy the logical demand for a common denominator--for general unifying concepts--a demand which the newer psychology neglects, even in its emphasis upon unit and wholes."

With respect to attention, the critical issue is not whether to find in it a dynamic principle of selection but whether the fact of selection at the level of conscious behavior is to be recognized as a problem in itself, and, being recognized, described..... Association, then is the problem of pattern. Attention is the problem of the form and limits of pattern."

Wilcocks (204, p. 266-319) published, in 1928, an elaborate series of experiments on attention and several conclusions based on these. His study was directed at the
relationship between (a) an expected stimulus which actually appeared as expected, and (b) an expected stimulus which appeared in a modified form; or to examine the statement: "A considerable number of writers have expressed, and more or less fully developed, the view that what is heterogeneous, in some respect or other, with the simultaneous or more immediately foregoing contents of consciousness, with previous experience in general, or with expectation, attracts or holds attention."

Wilcocks (204, p. 297) wrote further: "It is clear, firstly, that a certain amount of 'adaptation' of attention and reaction is needed for the reaction on the (changed stimulus) to take place.....made necessary by the fact that, whereas the subject expected or was accustomed to react on a stimulus having certain characteristics, he was unexpectedly to recognize and react on the stimulus where a change had taken place in its characteristics. Recognition and reaction tend to be delayed under these circumstances.....notwithstanding the fact that attention may be drawn to the critical reaction (stimulus) appearing unexpectedly.....; there is also evidence of an increase in the difficulty in recognizing it as the (stimulus) to be reacted on. We further find elements of surprise occurring in the reaction period in connection with the changed nature of the stimulus."
Moreover, Wilcocks (204, p. 298-299) stated that, "so far from a changed stimulus always drawing attention to the stimulus, heterogeneity (change) may act to cause such content or difference not to be attended to at all, or it is perceived as being in agreement with previous or immediately preceding experience; that is, there is a 'shift' in the direction of previous contents." This shift is further described (204, p. 302) as "a process of dependent apperceptive reproduction. Under these circumstances, a difference between the content presented and similar contents of previous or immediately foregoing experience, or with the content of expectation, does not draw attention." It may, in fact, be entirely overlooked. After some practice, however, (204, p. 305), there is greater cooperation between the central and the peripheral excitations and the stimulus is reacted to more quickly and more accurately because the sense organs give more attention to the unexpected stimulus and transmit the results more energetically to the central nervous system.

He (204, p. 317) pointed out that one can develop the habit of not attending to distracting stimuli. This inattention is at first voluntary, but becomes a determining tendency strengthened by repetition to act in a certain attentional way. He uses this idea to re-inforce his ideas (204, p. 318) on shift and overlooking.
James (101, p. 450) wrote on the subject of ignoring unwanted stimuli: "We do not notice the ticking of the clock, the noise of the city streets, the roaring of a brook near the house, etc. They lapse into unconsciousness as does any too unchanging (mental) content.... Millions of items of the outward order are presented to my senses which never properly enter into my experience--because they have no interest for me. My experience is what I agree to attend to. Only those items which I notice shape my mind. Without selective interest, experience is utter chaos. Interest (attention?) alone gives accent and emphasis, light and shade, background and foreground--intelligent perspective. Interest varies in every creature.....without it, the consciousness of every creature would be a gray chaotic indiscriminateness."

Wilcocks' (204, p. 267) theories and experiments are based on the hypothesis that, "other things being equal, the retention of and the ability to reproduce a content varies directly with (not necessarily, proportionately to) the degree of attention given the content at or after presentation," and that one may make use of this after-effect, or the memory effect, as a measure of the degree of attention which this content has had. In his emphasis on the importance of the peripheral nervous system, Wilcocks (204) is in direct contradiction with Chapman (39).
Reviewing the trend in attention theory, Paschal (144, p. 422) wrote, in 1940: "Within the past few years, the attention concept has been returning to the literature of psychology in several new forms. This is particularly true in textbooks where the new trend seems to have crept in unnoticed. Despite the dissimilarity of the descriptions, traditionally a characteristic of attention, there is to be found within them a certain common element. It can be traced back to the emphasis placed by the Functionalists on attention as a selective process. It was kept alive in the meantime chiefly in the psychologies of France and Italy, and was reviewed during the past decade in the form of an act of anticipatory adjustment."

Later, in 1941, Paschal (145, p. 383) wrote further: The importance of attention in the rational psychology of the past century was due to the closeness of its relationship to consciousness itself. The degree of consciousness, the intensity of consciousness, clearness of images or ideas, action of the will, the affective state (interest), the feeling of effort, the attitude of muscular tension, the preperceptive anticipation, exploration—all these were identified as being present in the attentive state, and at one time or another each was declared to be the essence of attention itself."

"The most popular of the psychological theories in the
latter part of the period (145, p. 384) was, of course, that which identified attention with clearness of consciousness..... When the Functionalist School appeared (c. 1890-1920), attention was assigned the role of selectivity. While the Functionalists made clear their position that in the plan of human adaptation the selection of stimuli operates by means of that process called attention, they were not in agreement as to how this selection takes place. Angell attributed it to an action of the will. Dewey called it an activity of the mind itself, and active association. James described it in terms of anticipatory adjustment..... Since that time (145, p. 385), most of the American textbooks have called attention a selective process, but the descriptive material has generally been influenced by the Structuralist emphasis on the phenomenal aspect."

"With the appearance of Behaviorism (145, p. 386), interest in attention began to decline. The cause of this regression is to be found in the swing in psychological methodology from an emphasis upon the phenomenal aspects of experience to the behavioral aspects and the consequent tendency to reject terminology that had acquired a mentalistic tinge. Watson ignored attention. Bekhterev reduced sensory attention to the reflex adjustment to the incoming stimulus and ideational attention to implicit
speech. Holt as spokesman for the Behaviorists.....established the pattern of their reaction by declaring that as the faculty of attention had been analyzed out, separating all the factors that belonged elsewhere, there remained only the core of clearness. Seeking that which, in behavior, would correspond to attention in cognition, he finds it in 'the process whereby the body assumes and exercises an adjustment or motor set such that its activities are some function of an object; are focused on the object.'"

"While systematic psychologists (145, p. 387) were questioning the validity of the term 'attention,' criticizing it as meaningless, unnecessary, and mentalistic, it continued to occupy a salient position in the various branches of psychology. The workers in these fields were undisturbed by the difference in views as to the essential nature of attention, but contented themselves with the commonsense interpretation. Psychiatrists, psychotechnicians, and educational psychologists were faced with the necessity of measuring attention variations or reactions whose major antecedents were attentional. Their studies have constituted almost the whole of the experimental literature (on attention) of the past decade."

"In the industrial and personnel fields (145, p. 387), it is a basic assumption that there is a trait (or traits) identified with the ability to pay attention and facility
in shifting attention which is essential to success in most operations. In consequence, batteries of occupational and aptitude tests regularly include tests of attention.....

The more frequent problems in psychotechnology are those of types of attention (the question of diffused versus concentrated attention), temporal span, spatial span, distractibility, fatigue effects, and proneness to accident. These problems have been particularly prominent in the literature of the new field of traffic research..... In the field of mental tests, the degree of concentration, freedom from perseveration, and range of attention have been tested, if not directly, then by an emphasis upon tests demanding the maintenance of a high level of efficiency..... The peculiarly close relationship of attention to intelligence has been emphasized by workers in the latter field from the time of Binet. As in the case of consciousness, the functional interdependence is such that a reliable measure of attention would seem one of the best indicators of the degree of intelligence..... Binet defined the levels of feeblemindedness in terms of attentional reactions."

"Psychopathology (145, p. 388) would find considerable difficulty in dispensing with this concept. Attention is looked upon as one of the more frequent and clinically significant correlates of neural disorder..... Among those having diagnostic values are the blocking of attention in
manic-depressive insanity, the heightened threshold in dementia praecox, the low span in hysteria, the inability to concentrate in mania, and the excessive fixation in paresis. In the diagnosis of brain injuries, lesions, and tumors, attentional deviations play a definite part."

"The point of view (145, p. 389) of the Behaviorists was followed by an emphasis on 'mental set' or preparatory set which placed attention in the peripheral nervous system and the accompanying muscle tonus; but just what this relation between set and attention is was not at all clearly stated. This was followed by a renewed emphasis on the central locus, or the distributive theory. This was, in turn, followed by the theory that attention was the mode of behavior exhibited after a stimulus has been received--but there was admission that attention reactions can be preliminary as well as behavioral. This is largely or entirely a renewal of James' position."

"With the advent (145, p. 393) of Organismic Psychology in the 1930's, attention was defined as a 'preliminary act of adjustment, characterized by the gathering of all of the forces of our being into a single organ of action.' This was something of a reversion to the view that attention is a set toward a specific reaction, but there was some trend toward an inclusion of the still common sensory adaptation theory. At least one writer, however, paid
attention to the work of the psychiatrists concerning the
distractibility of the insane by renewing that part of the
organismic view that attention involves the whole organism
rather than merely a selection by the sense organs. The
more recent textbooks have treated attention, if they have
mentioned it at all, as an anticipatory act, but there has
been confusion due to the influence of the idea that atten-
tion must include physiological operations. A still more
recent trend is that of including the much earlier ideas
that attention is both selective and distributive in the
central nervous system and is due to (a) a change from the
established level of stimulation, or (b) an anticipation of
an expected stimulus."

"One may summarize these fluctuations in theories of
attention as: (a) cognitive (selective and distributive);
(b) selective adaptation, mostly or entirely in the peri-
pheral nervous system; (c) reactional; (d) anticipatory;
(e) specifically a preparatory set; and (f) a return to the
cognitive theory of attention."

Paschal (145, p. 396-397) then called attention to the
inhibitory phase of attention; that is, the exclusion of
stimuli not to be attended to, which was implied in the
selective powers of attention but, usually, not mentioned
outright. He objected to the confinement of attention to
the field of sensory perception, and demanded consideration
of ideational attention in which implicit reactions--noticeably those of inner speech--provide for the maintenance and augmentation of a given pattern; but he, in turn, failed to include explicit reactions as well. He further (145, p. 401) questioned the desirability of getting away from the tangle of terminology and partial points of view by the adoption of a new term for attention, such as 'anticipatory adjustment,' but believes this to be not only unnecessary but undesirable. He stated that "the final test will be of the concept and not of its label. It remains to be seen whether such a redefinition will better serve the needs of psychotechnicians and psychiatrists and will stimulate more effective research than have some of the theories of the past."

Summary of the Section

In this section of the chapter containing a review of the literature on attention, definitions of the subject and some of its relations to other psychological phenomena have been presented in quite brief form. Some of the history of the subject has been presented also.

The earlier definitions of attention treated it as an all-pervasive psychological activity and an inherent part of human equipment. Later writers attempted to divide attention into two pairs of two parts each--(a) peripheral and
central, or (b) central and motor. Some writers have attempted to limit attention to one of these only. The writer of this thesis believes the older and inclusive attitude to represent the facts more correctly, clearly and usefully. Definitions are statements of concepts, and serve useful purposes. Even though attention is attached to, or is part of, all psychic life, the concept concerning it is valuable to educators, psychometricians, psychiatrists, and research workers in many parts of the business world.

The attention of the reader has been called to the close relationship of attention to interest, to consciousness, and to inner speech. The three divisions of attention— involuntary, voluntary, and nonvoluntary have been described; and the range, duration, and span of attention discussed.
Concentration

Urdahl (196, p. 330) defined concentration as "merely the art of bringing into action the elements of mind and the sources surrounding it to a particular object or subject," but does not define any of these elements of mind. The point is made, however, that "if your concentration were developed to the extent of your eyesight, nothing in God's creation would be difficult to accomplish."

Kremm (108, p. 84-90) studied, by means of the reading of meaningless, partially meaningful, and entirely meaningful material, and by simultaneously reading meaningful material and writing "4 0" and by cancellation of pairs of letters, the abilities of rural and of urban people to concentrate and to divide their attentions. The rural people were found to concentrate and to alternate their attentions better than the urban people, while the urban people were able to divide their attentions more successfully. His number of subjects, thirty rural and twelve urban adults, was very small.

The number of studies of concentrated attention is no doubt as small as it is because the term is somewhat intangible and may represent a degree rather than a kind of attention. The theoreticians about attention rarely so
much as mention it, notwithstanding its importance in daily life.

Span of Attention

The study of the simple span of attention was quite well covered many decades ago, the span of attention being defined as the number of objects which could be attended to or perceived in a brief fragment of time. These experiments usually involved the use of the tachistoscope and cards bearing either similar or different letters or other symbols, alone or in groups. If groups of zeros, for example, were shown in the form of six groups of seven each or seven groups of six each, the span of attention could often cover them and the Subject could correctly report that forty-two zeros had been observed in the tenth or the twentieth of a second of exposure. A few Subjects could exceed this, but the majority could not reach it. As the material shown became more complicated and different, the number of objects which could be grasped decreased—unless the time of presentation were increased.

James (101, p. 405) wrote, in 1890: "To how many things can we attend at once? The number is altogether indefinite, depending on the power of the individual intellect, on the form of apprehension, and on what the things are. When they are apprehended as a connected system, the
number may be very large. Where the object before us breaks into parts disconnected with each other and forming a separate object or system, not conceivably in union with the rest, it becomes harder to apprehend all these parts at once, and the mind tends to let go of one while it attends to another."

Biemuller (17, p. 162) studied the organization of similar material in different arrangements by using a special form of tachistoscope whereby groups of three to twelve marbles could be released at one time on an inclined plane. The marbles, then, were to be replaced by the Subject in the form in which they had been perceived. He found that the previous limits of five or six marbles was maintained only for the groups in irregular masses. The accuracy of replacement of the marbles by the Subjects paralleled the amount of organization of their earlier arrangement. The Subjects could reproduce a whole without knowing the exact number of marbles in the whole though they did know the numbers in each channel or part. The number of marbles in organized wholes was often underestimated, while dissimilar arrangements were overestimated.

Oberly (142, p. 301-302) prepared 130 sets of digit cards, ten in each series, bearing from two to fourteen (inclusive) digits. These were presented in a haphazard order. His purpose was a comparison of the spans of
attention and of memory. He found that: "Individual methods of grouping are used in memory spans for the longer series; there is little difference in test results whether the digits are presented in serial or haphazard order; visual imagery is of little aid in reproducing the longer series of digits; and the attention span limen ranges from 2.5 to 8, while the memory span limen ranges from 6 to 13.5." This last conclusion is, to this writer, a most remarkable one because it implies a memory of something which was not perceived.

Morton (137, p. 553-558) was interested in the relationship between the Subject's ratings of the visual clearness of the presented material and the span of apprehension (attention). Cards were presented in the tachistoscope for 0.06 of a second. These cards bore (a) eight letters of same size, color, and relative position; or (b) seven letters of the same size, color, and relative position and an eighth which was varied in one of these respects. Three conclusions were reached: (a) All types of variation used among the letters enhanced the clearness of the letters; (b) this enhancement was accompanied by a decrease in the span of attention; and (c) no reliable correlation between the magnitude of the increase in the clearness and the decrease in span was found under the conditions of this experiment. In a later, similar,
but more complex experiment, Morton found a negative corre-
lation between degree of clearness and of span, ranging
from 0.00 to minus 0.61, with a mean of minus 0.35, using
forty measurements for each Subject. The ages of the Sub-
jects and their scores on the Otis Self-Administering Test
of Mental Age, Form D, were unrelated to the sizes of the
correlations. "Clearness" was estimated from introspective
report.

Chapman and Brown (40, p. 364) had made a similar but
earlier experiment to that of Morton, and had arrived at
the same conclusions.

Gill and Dallenback (77, p. 247-256), in 1927, made a
study of what they called the "range" of attention but what
is more usually called the "span" of attention. They used
white cards with cut-outs stamped in them so that the black
background showed through these designs as small circles,
large circles, semi-circles, triangles, diamonds and simi-
lar forms. Their conclusions were that: (a) size and form
are effective in gaining attention, but position and pat-
tern are not; (b) "grouping" of stimuli is not dependent on
the objective arrangement of the stimuli as much as it is
on subjective disposition; and, under the conditions of the
experiment, the span of attention varied from seventeen to
forty-two stimulus-objects. Another of their conclusions
was that "the law of two levels" was confirmed; that is,
the processes of consciousness may be divided into the clear and unclear levels. It would seem to the writer of this thesis that clearness is not divisible into two levels, but is in a series of gradations from very unclear to very clear.

Hart (88, p. 275-283) made a series of experiments on the effect of colored stimuli on the "span" of attention, although he, too, called it the "range" of attention. He found that the threshold (lowest perceivable stimulation) was largest for red stimuli, smallest for green, with yellow and blue in between. The brightness and the saturation of the colors of the stimuli did not seem to account for the difference in the thresholds.

Distribution, Fluctuation, Alternation

The "distribution" of attention may be contrasted with the "concentration" of attention. It is sometimes defined as the number of things which can be attended to in a few seconds or few minutes of time; and sometimes, as the ability to give concentrated attention to a series of stimuli or events, together with the consequent actions, including any changes of attention in any direction among the stimulus objects.

Earle (52, p. 215) made a study involving the above ideas and also the possibility of concentration and
distribution being the opposite poles of one special mental factor as proposed by Spearman. Earle also called attention to the practical problem of attention as faced by such people as managers, foremen, salesmen, nurses, machine tenders, and bus drivers— an idea which the theoreticians should have considered. He, among others, also considered the influence of such psychological factors as interest, manipulative skill, and intelligence upon attention and the reactions through which they are measured; and, in his experiments, tried to control these factors, where others had, apparently, taken them for granted. He further stressed the elimination of the time element in some of his experiments to bring his study of distributed attention more into relation with such practical activities as driving a car in which, while attention must be divided among various stimuli and appropriate responses, there is seldom need for the highest speed of response. It might be, in these practical situations, that speed of reaction in terms of thousandths of a second might well be classified as "flurry" and as inefficiency in which important signs might be overlooked, their significance perceived too slowly, or a congestion of mental processes and unsatisfactory responses might occur. On the other hand, there is the equally unsatisfactory slowness of the novice, the dull person, or the uninterested person.
In Earle's first experiment (52, p. 221-222), he duplicated a factory inspectional process which involved the examination of at least three parts of a diagram and in which success depended upon the intensity of concentration of the attention and the accuracy and speed of perception. Manipulative skill and memory played very minor parts.

In his second experiment (52, p. 223), he presented to the Subjects' view an endless band or drum which was four drawings wide. Whenever any one of three particular drawings appeared, the Subject was to place a card similar to the drawing shown in a box labeled with an identical card.

For his third experiment (52, p. 226), he prepared forty rectilinear drawings which were similar in general outline but dissimilar in their parts. These were arranged in pairs. One of the pair was presented to the Subject for ten seconds. It was then covered, and the other exposed in the same way. The Subject was then to state that the pair were alike, or indicate in what respects they differed. This experiment involved ability in spatial imagery; but Earle did not, apparently, consider this.

In his fourth experiment, Earle (52, p. 227) presented eight rectilinear diagrams of gradually increasing complexity, one at a time for fifteen seconds each. After each exposure, the Subject was asked to sketch the diagram which he had just seen as accurately as possible for shape and
proportion. In all of Earle's experiments, his Subjects were forty-one girls and thirty-nine boys between the ages of thirteen-years-and-nine-months and thirteen-years-and eleven months.

Earle's summary (52, p. 236-241) contained the following points: The problems of measuring differences in the abilities of persons to "pay attention" are difficult ones. It is, apparently, impossible to avoid the complications of other factors and, although one may reduce the effects of experience or of acquired manual dexterities, he cannot remove the influence of general intelligence or "whatever that general ability may be which finds expression in all mental activities." "It has been suggested that the so-called general intelligence is in fact the ability to 'pay attention'...... While it may be true that the quality of attention is a factor in the intelligence of behavior, it hardly seems likely that intelligence and the quality of attention are identical...... There can be no doubt as to the generality of some factor underlying success in all of the tests described in this report......but the correlations between tests specially introduced as measures of 'attention' and those in which the 'g' (general) factor is apparently predominant is not as high as might be expected...... Looked at in this way (52, p. 239), there are not differences in the nature of attention as between its concentration and
its diffusion; but there are differences in the rate of succession and in the intensity of attention necessary for the purposes of the moment..... A state of 'balance' tends to be set up in which attention to each important stimulus is given at such intensity that the sequence (of reactions) can be successfully maintained. It would appear that a tendency to concentration upon any one stimulus prevents such an equilibrium; hence, a person who habitually thus concentrates must fail..... Even though he carries through the complete task by a succession of attentions to parts of it (as the majority of persons will do), it is probable that a too high intensity of attention to any single part will interfere with the most successful attention to the remainder."

Earle (52, p. 240-241) wrote that specific factors are large in distributed attention because: (a) various tasks call for special adaptations based upon knowledge, acquired skills, or special sensory or muscular equipment; (b) individuals differ in sensory acuity and muscular adaptation; (c) the "natural rate of reaction" of the individual may be different from that required for the task; and (d) the rate of change in degree of attention may vary from task to task; in other words, attention is subject to training. This statement is in contrast with the point of view of many "systematic" psychologists.
Bassi (11, p. 284-285) (12, p. 67-74) had 100 Subjects perform various continued tasks, first separately and then together. He concluded that it is difficult to consider the capacity for distribution of attention as a special psychological factor; but that it is, rather, a general psychological factor.

Verwoerd (198, p. 496), in 1928, made an elaborate study of Piorkowski's "Attention-and-Fatigue Meter" with 100 Subjects. This apparatus consists of a rectangular box with a row of ten openings in the top, a reaction button opposite each opening. White strips are made to appear at irregular intervals in the various openings. Two electric counters are attached—one to register the number of white strips appearing, the other to register the number correctly reacted to. The number of correct reactions during a period of several minutes was taken as a measure of the distribution of the Subject's attention. Verwoerd (198, p. 501) believed, however, that the results could be looked upon as "distributions of marginal consciousness and automatic acting" and not as tests of the distribution of attention. Alterations can (198, p. 510), however, be made in the apparatus to enable one to test the distribution of attention. He issued the warning (198, p. 509) that vocational psychologists should not wish to make use of tests merely because of their correlation with a more or less
imperfect criterion, but should have tests which they can
look upon as measuring certain definite mental qualities.

Arbuzov and Gurevich (6, p. 263-269) criticised
Piorkowski's test of attention as failing to bring about the
dispersion of attention which it is supposed to measure,
measuring instead visual-motor coordination principally.

Neifakh (141, p. 369-371) proposed several modifications
of Piorkowski's test of attention, using as criteria
the critical remarks of Verwoerd (198). His most important
modification was one which permitted the test to be given
simultaneously to several Subjects by one operator.

Makovetski (117, p. 372) described a new apparatus for
the study of distributed attention which was a modification
of Piorkowski's and which used arrangements of electric
lights. The advantages claimed for it were: disturbing
sounds were eliminated; the appearance of the signal and
the possibility of response were synchronized; the speed
could be regulated within large limits; and the mechanism
was simplified. He merely described the apparatus; offer-
ing no conclusions from its use.

Lahy (112, p. 304-308) devised an apparatus somewhat
similar to Piorkowski's in which the Subject is to press
certain keys when specific letters appear in groups of five
on a band passing behind a rectangular window. The
reaction times and the errors were recorded. Norms, based
on 300 Subjects, were given; but no particular conclusions were offered. Targonski (186, p. 24-32) used this apparatus with complicating additions on 700 Subjects. He found that aptitude on the test diminished with age in both precision and rapidity of motor reactions.

Wojcischowski (208, p. 459-460) devised a more intriguing means of studying attention through reaction time. Six parallel railroad tracks have six small cars running on them, moving according to an irregular schedule. Each of the cars can be controlled by a lever operated by the Subject. His task is to stop each car just before it strikes a given indicator and makes an electric contact. Errors are recorded automatically. This apparatus was designed for use in Polish railway laboratories.

While the division of people into constitutional types based on body structure (Kretschmer) has been largely abandoned, Enke and Laurrenz (57, p. 634-644) studied 180 persons on two tasks involving geometric figures as measures of distributed attention. They found that the pyknics showed much less ability than the leptosome and athletic persons. When the task was modified so that the figures were uncolored and were to be counted within a limited time, the leptosomes and the athletics made the poorer records and the pyknics the better records. Apparently, the color caused confusion among the pyknics and the time
element caused confusion among the other groups. According to these writers, the scores were not influenced by the ages of the Subjects—testifying that age itself does not essentially change the constitutional type. The experiments involved 240 persons between the ages of sixteen and sixty.

In contrast, Biegeleisen (16, p. 31-83), using a group of cancellation tests and tests of intelligence on normal and subnormal children and adults, found no character or constitutional types to be revealed by the tests. He further found the correlations among the cancellation tests themselves, and between the cancellation and the intelligence tests, to be low; and stated that the cancellation tests measured other modes of behavior than attention.

Reiter and Sterzinger (153, p. 131-132) found some indication of a relationship between the range of attention and constitutional types, but found it not sufficiently clear for diagnostic purposes. They found mixed constitutional types to be very common also.

Spilker (178) found introverts to possess a strong tendency to consider stimuli systematically, while extroverts were inclined toward fusing the objects in attention. Both types were found to be similar in respect to the effects of practice.

Sterzinger (180, p. 177-196) made a critical
examination of the techniques used in the testing of the ability to distribute attention, using as an example the reading of a story and the solving of multiple problems. In any such experiment, it is desirable to know whether one is dealing with simultaneous and distributed attention or with a series of rapid alternations of attention. He also criticized the attention test of Piorkowski and others as being unsuccessful measures of occupational aptitude.

Using the terms "oscillation of attention" or "fluctuation of attention" to mean variation in attention within the central nervous system, Flugel (65, p. 1-48), in 1934, criticized earlier studies for not considering individual differences. He found high correlation among eight tasks as performed by eleven Subjects in terms of individual oscillations, and believed that there is a psychological factor for this trait. It is, apparently, unrelated to fluctuation with reversible cubes, threshold stimuli, or reaction times.

Madigan (116, p. 338) pursued Flugel's work (65) further by means of statistical analysis of the oscillations of attention. According to Madigan, practice in no way affects the scores on tests of oscillation. The data on oscillation from adults and from children show similar results. There is some evidence that children oscillate over a wider range than adults do. Oscillation is a very
definite component in human abilities.

Philpott (148, p. 221-255) attempted to develop a curve of the fluctuation of attention on the basis of mental work, and found that such theoretical curves approximated the outlines of actual work curves in experiments on attention.

Warburton (201, p. 162-171) assumed the usability of Philpott's curve of the fluctuation of attention, and experimented upon the effect of interruption-by-rest upon the construction of such a curve. Instead of using work periods of five seconds as Philpott had, Warburton used work periods of much longer but of indeterminate lengths. Each of 100 children had four sittings at the task, each sitting broken by a rest period of five, ten, twenty, or forty seconds. His conclusions were that the curve of output in simple addition is characterized by cycles of geometric periodicity. These geometric cycles run through the complete task, cutting across periods of rest. Other geometric cycles commence immediately after rest.

James (101, p. 408) covered this phenomenon well as long ago as 1890. He wrote that attention, often, but not always, oscillates in the performance of experiments on doing two things at once. In such experiments, the beginnings of each segment are what require attention. "If the original question means how many entirely disconnected
systems or processes of conception can go on simultaneously, the answer is—not easily more than one, unless the processes are very habitual; but then, two, or even three, without very much oscillation of the attention. Where the processes are less automatic, as for example, Julius Caesar dictating four letters while he writes a fifth, there must be rapid oscillation of the mind from one to the next, so no consequent gain of time. Within any one of the systems the parts may be numberless, but we attend to them collectively when we conceive the whole which they form.

Tests of Attention

Easley (53, p. 203-204) attempted several things in his experiments in 1931: (a) whether the current tests of attention measure some special factor which may be called attention; (b) if they do, the extent to which attention determines the score on the test; (c) the extent to which attention and its measurement are involved in certain broader mental functions. He used as tests:

1) two "A" cancellation tests
2) a word-finding test; e.g., brloeyeldcat
3) the Woodrow test, in which the difference between the score on a test taken under optimum conditions and under unfavorable conditions is taken as a measurement of attention
4) simple reaction time
5) Army Alpha Intelligence Test
6) Otis Test of Mental Abilities

7) an equation test, a large page bearing incomplete arithmetic equations in which signs have to be written in, to make the equations true

8) a digit-symbol and a symbol-digit test

9) a word-building test, in which one is to make as many words as possible out of six letters supplied; e.g., E A I R L P

10) classroom grades in general psychology

Easley's conclusions were (53, p. 214-215):

1) There is little or no relationship among the several measures of "attention";

2) There is little or no relationship between the measures of attention and the measures of the other mental functions which we should suppose to require a high degree of attention;

3) There is no evidence of any group factor of attention involved in any combination of the tests of attention;

4) If attention is involved in all of the measures to any extent, then the intelligence tests are at least as good measures of it as the tests of attention are;

5) The direct and the indirect methods of measuring attention do not measure the same thing, even in the same function, namely, reaction time.

Madame Pieron (149, p. 105-112) designed a cancellation test, the Toulouse-Pieron test, requiring the cancellation of one, two, or more, kinds of signs in a variety of eight scattered through a page of 1600 signs arranged in a random order. It was planned as a "test of professional orientation" to replace the "a-cancellation test." The test was
described without conclusions being offered.

Gozzano (78, p. 29-48) used the Toulouse-Pieron Tests of attention under varying conditions with 665 children between the ages of eight and thirteen years. He found the single cancellation form superior to the other two; and that a four-minute work period measured attention as well as longer work periods.

Meili and Daiu (129, p. 113-133) devised a technique which yielded a work curve for the Toulouse-Pieron Test. This curve was held to be helpful in interpreting the results obtained from the test, the significance of which is not clear. Correlations with other tests, which are in part very similar, are very small; and the authors have not yet succeeded in giving an adequate explanation of this fact.

Lopez (114, p. 40-62) employed the Toulouse-Pieron Test of attention in an experiment emphasizing the speed and the accuracy factors in the cancellation of three of eight kinds of symbols, using seventy-six adults. The correlation between speed and accuracy was found to be minus .269. Efficiency of attention as determined in this experiment was greatly influenced by speed, and was held by the author not to give a satisfactory unified evaluation of attention.

Gamia and Salkind (75, p. 307-319) studied the values
of five tests of attention with ninety girls aged nine, twelve, and fifteen years, and with fifty women students. The tests used were:

(1) The Rybakoff Test I, which consists of points of color to be counted;

(2) The Schultze Number-Square Test, which consists of numbers between eleven and fifty-nine to be arranged in a natural order;

(3) The Toulouse-Fieron Test;

(4) The Rossolino Test, which consists of holes to be pierced according to certain patterns;

(5) The Rybakoff Test II, which consists of a mixture of squares and crosses to be counted.

These authors found the correlations between these tests of attention to be positive, but almost negligible (.09 to .37). The relative gains from one age to another were found to be irregular.

Rivesz (155, p. 158-170) proposed a simplified test of attention in which a three-place number is given to the subject who is told to add first one, then two, then three, and so on, to this number for ten minutes. He claimed that this test gives more reliable results, is easier to evaluate, and requires less time than other somewhat similar tests; but he was not specific in supporting his claims.

Sal y Rosas (159) used Valdizan's Cancellation Test as a measure of the intensity and the stability of attention. The test calls for the cancellation of some zeros but not
of others, depending upon the order of appearance. He used 195 Subjects, between the ages of twenty and thirty years, but did not state the length of the work period. A typical fatigue effect appeared in all of the curves of performance.

Musgrave and Metfessel (139) used a film presenting twenty-five brief glimpses of a circle of letters, numbered like the face of a clock. For each glimpse, the Subjects were told to observe the presentation passively and to record the position of the letters to which their eyes were attracted. The five factors allegedly to be studied were: "magnitude, intensity, motion, quality, and repetition."

Chang (38, p. 51-57) studied the relation of positions on a plane (horizontal) and their attention values. Cards with words and numbers were used as materials and were presented to the Subjects in various ways. It was found that visual attention is a complex response and that at the change of even a part of the situation, the whole thing would change also. Several things were noted: "(1) Objects in the more stable position on the plane will attract attention more easily, while those in the moving position require a longer time for concentration of the attention; (2) Pictorial illustrations must be put at a comparatively stable position on the page; for instance, in textbooks printed from right to left, pictures and diagrams should be placed at the left half of the page, while in textbooks
printed from left to right, the position should be reversed."

Saltzman and Garner (158, p. 240-241) compared the usefulness of a tachistoscopic presentation of material for five-tenths of a second with the presentation of the same objects for such time as was needed for their apprehension. The scores were the numbers of objects apprehended versus the lengths of time required. Their principal conclusion was that the tachistoscope technique of the measurement of attention is a measure of reaction time rather than of attention.

Bedini (14, p. 125-129) described a test of distributive attention consisting of forty disks of five different colors located at different points on five vertical lines of the same colors but with the color of the disk being different from the color of the line on which it was located. The Subject is required to draw a line from the blue disk at the bottom of the page so as to unite the other thirty-nine disks by going always to the disk which is found on a vertical line that has the same color as the disk which he has just left. Migliorino (132, p. 154-171) used this test with 100 persons divided among (a) a group of intellectuals, (b) a group of women, and (c) a group of laborers, chauffeurs, and railway laborers. While both writers discussed their results, they arrived at no
positive conclusions.

Hackman and Guilford (85, p. 58-59) used Nixon's visual presentation method of measuring the attention value of stimuli, but augmented it with the use of an eye-movement camera. Their results showed that the amounts of immediate recall and the direction of the first eye-movements are better indications of attention than length of time spent in looking to the right or to the left.

Brandt (23, p. 405-426) used the eye-camera to measure attention as it was shown by immediate recall of memorized material and by length of visual fixation as an evidence of interest. Three experiments were reported in which eye movements were photographed while the Subjects observed material for twenty, ten, and fifteen seconds, respectively. First, the Subjects were required to observe and memorize the arrangement of small blocks symmetrically grouped on a white ground. It was found that the number of fixations was about four per second; that not more than three or four fixations were made without changing the direction of excursions, that horizontal excursions were more frequent and extensive than vertical excursions, and that 66% of fixations were in the left half of the field, and 61% above the midline. Second, when two cards with four identical figures differently arranged were presented to two groups, about one-third of the time was spent on the
upper left hand figure, slightly less on the upper right, less on the lower left, and least on the lower right. Achievement in reproduction correlated fairly well with time spent in observation. Third, when two pages from a mail order catalogue were presented, men spent about two-thirds of the time looking at the men's page, regardless of its position, while women showed a lesser degree of concentration on the women's page.

Baumgarten and Tramer (13, p. 146-149) proposed a performance quotient in connection with cancellation tests of attention. Maintaining that enumeration of errors is not satisfactory as the tasks increase in difficulty from trial to trial, they proposed that the number of errors made be divided by the number of possible errors at each level, the result multiplied by 100, and a per cent or performance score established. Such a procedure would facilitate intra- and inter-individual comparisons.

Mailer and Elkin (118) sought to get at attention by means of perseveration or the persistence of attention to continue in a direction which was being followed after a change in direction had been called for. They suggested that the ratio of the scores after the shift, divided by the scores before, be called a "perseveration quotient." For sixty-six cases, this quotient correlated .008 with intelligence quotients. The authors believed, however,
that the perseveration quotient might have some analytical values in the study of personality.

Sarkar (161, p. 35-40) studied the attention or observation errors of good and of poor observers by exposing fifteen stimulus cards, each bearing a series of seven letters, for two-tenths of a second each. He believed that "attending is a process of connecting," that is, the good observers established mental connections between the stimulus material and the present quickly and accurately, while the poor observers connected their mental associations with the past and the future. "Attention is made up of selective activities involving the crude beginnings of valuing or judging."

Cronbach (42, p. 197-222) made an elaborate study of individual differences in learning to reproduce forms as a measure of attention. He used an eye-camera and informal interviews on the Subjects' study habits. His conclusions were that learning to reproduce forms is "exceedingly complicated," that study methods vary among individuals, and that study methods affect the quality of performance under these conditions.

Philip (147) attempted to measure concentrated attention. He first found the mean reaction times and their mean variations for forty-nine male college seniors and then used the differences in reaction times under varying
conditions of reacting as the criterion of attention. He also used a battery of tests consisting of: "compound number span," with letters interspersed; mental multiplication; mental addition of numbers placed horizontally instead of vertically; and cancellation of three sets of symbols at one time. The results from the battery of tests correlated with the differences in reaction times plus .596, and was claimed to measure the validity of the battery of tests. Philip used this battery of tests on 1600 school children, ranging in age from ten to nineteen years, and worked out growth curves for each of the subtests. According to Philip, most of these curves reached a plateau when the children were fifteen years of age; but, using a sampling of 243 children, he found a correlation of plus .09 only, between the scores on these subtests and mental age.

**Distractions**

The effects of distractions and the characteristics of these effects are of interest in the study of attention and may even be a method of measuring attention. As early as 1918, Cassel and Dallenbach (37, p. 129-143) observed that distractions served generally to lengthen reaction times, but sometimes shortened them, and occasionally, after a brief initial disturbance left them unaffected. Certain noises which are distracting to some people have no effect
upon others. To people accustomed to working in noisy surroundings, quiet would be distracting.

Dulsky (50, p. 590-592) has made the statement that all distractions are intermittent—otherwise the Subject would not be able to perform the task set—but some Subjects do give up with the task undone and others quickly learn to exclude the distraction apparently almost completely. He suggested a differentiation between the effects of distraction upon (a) attention and (b) performance. Whether this differentiation would be useful or not remains to be established.

Obsta and others (143, p. 255-261) had children and adults work at letter cancellation and at addition under conditions of silence, music, and noise; they came to the obvious conclusion that music and noise generally caused a decrease in speed and accuracy of performance.

Hiratsuka (94, p. 283-304) found the disturbing effect of noise upon mental work to be slight in normal persons both quantitatively and qualitatively and to be sometimes beneficial by reason of inducing greater effort. Freeman (68, p. 360) found only a temporary reduction in work output upon the introduction of noise distraction.

Miller (135, p. 105-118) found that the habit of studying with the radio playing, or entirely silent, had little or no effect on the ability in several reading
tests, and counted reading to be the basis of most high school study performance.

On the other hand, Henderson, Crews, and Barlow (91, p. 313-317) found that popular music distracted a group of subjects on the paragraph section of the Nelson, Denny Reading Test, but not on the vocabulary section; while classical music showed no evidence of distraction in either. Pupils accustomed to having a radio playing while studying were distracted to the same extent in the test situation as were the pupils not accustomed to a radio playing while studying. These writers held that whether music serves as a distraction, or not, depends (a) upon the complexity of the music, and (b) upon the complexity of the test materials.

In still another study, Fendrick (64, p. 264-271) found that classical music reduced efficiency in reading. Since he did not equate his groups and since he used only one type of distraction, his study is subject to question.

Super, Braasch, and Shay (185, p. 373-377) studied the effects of distractions on people taking tests, in order to try out the usual requirement that places in which tests are taken should be free from distraction. Two groups of graduate students took the Minnesota Vocational Test for Clerical Workers and the Otis Test of Mental Ability. Several commonly occurring distractions were staged, for one
group, during the 'numbers' part of the Clerical Test and during the Otis Test. None of the Subjects was aware of the purpose of the experiment. "No statistically significant differences were found. The commonly occurring distractions do not affect test results." These writers should have modified their conclusions to allow for special individuals who are "nervous" or unstable, and for others who are not as well disciplined as graduate students.

Nance and others (140) made a preliminary study of the use of lights as distractors upon performance with the Washburn Serial Coordination Test, but presented no conclusions.

James (101, p. 430-431) summarized the influences of distractions thus: "The reaction time is always more or less prolonged when an impression which is anticipated both in point of quality and strength is accompanied by other stimuli which make concentration of attention difficult..... as when a momentary impression is registered in the midst of another." He cited an experiment in which a bell was sounded in a regular pattern as a distraction and then the distraction was further complicated by irregularly intermittent noises.

Tinker (190, p. 467-468) made a study of controlled kinds of distractions upon performance. He found that small distractions in a regular pattern usually brought
about greater production but at the same time required more effort from the learner. Larger distractions in a regular pattern reduced production slightly and required much more effort in their resistance. Small distractions in an irregular pattern further decreased production and required still more effort, while large irregular distractions made production practically impossible through efforts to anticipate and protect oneself against the next distracting stimulus.

Finger tremor is both fairly well fixed and fairly constant in an individual. Edwards (55, p. 503-509) (56, p. 590-591) studied tremor—when attention was fixed—and found no increase in it under either quiet or distracting conditions. Under conditions of shifting attention and even slight distractions, the increase in tremor was large and consistent. This conclusion has, according to Edwards, implications for vocational placement and one-armed driving. Edwards (55, p. 503-509) studied involuntary or uncontrolled movements, as shown by finger tremor, and their effects on automobile driving in a laboratory situation. He stated, however, that the results should be checked against actual driving situations. He found that with "shifting attention and slight distractions, the increase in involuntary hand and arm movement was large, consistent, and statistically
significant..... We may perhaps surmise that with the varying conditions of driving or of similar occupations, the varying amounts of monotony, emotional excitement, and various distractions might produce much more uncontrolled movement than we have found in the laboratory."

As an application of his material, Edwards (55, p. 503-509) suggested that not only should epileptics and paretics not be permitted to drive automobiles, or engage in other activities in which uncontrolled movements would be dangerous to the individual or to others, but certain so-called normal persons with extreme uncontrolled movements should not be so employed either.

Cameron and Margarett (35, p. 617-627) had fifty-six college women complete incomplete sentences under conditions of quiet and of distraction. Fewer items were completed or were recallable from the material worked on under distracting conditions.

An application of the study of attention was devised by Ewing (59, p. 368-370) which used a "listening index" in classes in public speaking as a means of improving the later speeches of the listeners through avoidance of errors and weaknesses noted in the speeches heard. The procedure appeared to have a desirable effect. This study was held to be one involving "directed attention." Along this same line, Brown (26, p. 139-146) constructed two tests to
measure accurate and critical listening comprehension. His conclusions after administering the tests were that listening comprehension is substantially related to intelligence, somewhat related to silent reading ability, and somewhat related to scholastic achievement.

In Cason's (36, p. 532-546) study of the effects of distractions introduced after the Subjects had started to work on addition, paired associates, arithmetic problem-solving, and two recreational reading activities, he found that, in spite of greater effort, efficiency was decreased, and the distractions caused it to be more difficult for the Subjects to work.

Schacter (162, p. 339-371) made a study of the attention of pre-school children that is characteristic of the many similar studies which have been made, but was worked out with considerable more care than were many of the others. She postulated (162, p. 339) the following: "That there exists a state of indecision and uncertainty as to just what one may expect of pre-school children in the matter of attention is evident to anyone having any direct contact with them, or having acquaintance with the literature concerning the numerous manifestations of attention. .....Granted that the child's attention is volatile; it can be attracted, but can it be held, and if so, for how long? What factors are involved, not in gaining the attention of
the child, but in retaining it? Are there age differences noticeable in sustained attention in the pre-school years? Can we say when we may legitimately expect the normal child to be ready for prolonged periods of sustained attention? Is there a sex differentiation in the sustaining of attention?"

In making her study, Schachter (162, p. 348) defined attention "span" (actually "duration") as the time during which a given activity is continued without external persuasion or compulsion. The Subjects were thirty-six children, ranging in age from three years to five-years-nine-months--six boys and six girls at each year-level.

Three tasks (162, p. 350-351) which were designated as simple and three as complex were performed by these Subjects (162, p. 348). Task I (simple) required the placing of paper disks an inch in diameter and of six different colors in rows of three different colors on a table. Task II (complex) involved the placing of two pictures of kittens, birds, et cetera, and one geometric figure in rows of three on the table. Task III (simple) required the dropping of pegs taken from one box through a hole in the cover of another box. Task IV (complex) required the dropping of round, oval, or square wooden beads into a box, one kind at a time. Task V (simple) involved the filling of a rod with wooden disks, three at a time. Task VI (complex)
required the filling of five rods, each with a differently shaped disk already on it, with disks of the same shape.

The conclusions offered by Schacter (162, p. 362-363) were: "There was no significant difference in the sustained attention of three-, four-, and five-year-old children in simple tasks. Each group showed a consistently greater span (duration) of attention for the complex situations. At each age level, the girls showed a longer period of sustained attention than did the boys, although the difference decreased with age. The average period of sustained attention for the simple tasks was eight minutes and thirty-nine seconds, with a standard deviation of five minutes and twenty seconds, and a range of from two minutes and nineteen seconds to twenty-one minutes and fifty-one seconds. The average period of sustained attention for the complex tasks was eleven minutes and forty-four seconds, with a standard deviation of six minutes and twenty-five seconds, and a range of from four minutes and twenty-six seconds to thirty-two minutes and thirty-four seconds. The purpose of this study was, of course, the answering of the questions asked by the author (162, p. 339).

Brown (27, p. 255-291) used the continuous reaction method as a measure of attention to a simple motor act with young children. Her results showed that the attention of young children tended to improve during the experiment,
that original fixation on one or more of the details gradually shifted to apprehension and control of all of the elements involved, and that the initial attention correlated fairly well with either the best or the final performance but not appreciably with any other of the measures used.

Miles (133, p. 1-5) used fifty-eight children, aged three through six years, in a situation demanding sustained visual fixation in a delayed stimulus response to find the length of such fixation at the chronological ages employed. A 'jack-in-box' device which could be controlled by the experimenter was employed because it would be intrinsically more interesting to the children. Her conclusions were that there was a distinct differentiation for the different age groups in respect to the mean fixation time. The two younger groups--ages three and four--were approximately identical in the length of time they maintained visual fixation on a delayed stimulus. A distinct break, however, occurred between the four-year and the five-year groups. Sex differences in relation to fixation time were small.

"The close relationship commonly thought to exist between intelligence and attention is not verified by results from this study. Rather one must conclude that there is only a very slight relationship existent between the general attentive factor and intelligence--contrary to all dictums
of the past—or that the highly intelligent child will vary decidedly in the attentiveness of his behavior according to the nature of the situation in which he is placed. The latter explanation seems more plausible and indicates that the term 'attention' is merely a descriptive category of behavior." It would seem to the writer of this thesis that Miles erred in her last assumption, and that she has been guilty of making a general assumption out of a particular or partial assumption.

Wittenborn (206, p. 19-35) employed a new and different approach, using factor analysis to study results obtained from tests designed to measure attention. He found attention to be independent of the factors of rote memory, visual spatial imagery, number, and perception; and, to a large extent, independent of the content and the mode of presentation of the test material. He found that attention appeared most clearly in tests requiring a large amount of sustained and relatively continuous mental effort.

In order to study the spread or distribution of attention among various complex visual stimuli, Wilcocks (204, p. 266-319) used seven kinds of stimulus-situations in as many separate experiments. The first involved stimulus cards bearing eleven letters of the same size and color plus one letter of the same size but a different color. He
used four sets of these cards, each with a different pair of colors. In the second experiment, he used three sets of six series of nineteen nonsense syllables. In his third experiment, he used a motion picture film showing a series of letters which were stationary, with an additional one which moved forward and backward. In the fourth experiment, again with a motion picture film, all of the letters except one were in motion. In the fifth experiment, the Subjects worked under conditions of auditory distraction for a time and then the distraction was stopped suddenly. In the sixth experiment, the Subjects were to react to one of four letters shown on a series of cards. These letters were all of the same size and color except the stimulus letter on the last card which was of a different color. The Subject was not apprised of the change beforehand. In the seventh experiment, cards bearing twelve letters each were used. Eleven of the letters were blue and the twelfth red on some of the cards and on others these conditions were reversed.

Guilford and Ewart (80, p. 554-563) studied the effect of colored and of black-and-white advertisements upon reaction times to the presentation of pages from women's magazines. They found that the reaction times to the reading matter were longer when attractive advertisements were present, probably due to the "distracting effect,"
or the "pulling power" of the advertisements. No significant difference was found between the distractive effects of colored and of uncolored advertisements. A third conclusion was that: "It is our view that recognition scores, as compared with other criteria of attention to stimuli, are heavily contaminated with factors other than differences in attention and hence cannot be used as unadulterated indicators of the attention-value of stimuli." It was also found that the distractive influence of the advertisements decreased during the course of the study, probably due more to decreased attention than to decreased interest. The authors of this article (80) believed their procedure supplied a successful and even delicate measuring instrument of the attention-values of stimuli, especially of magazine advertisements.

In summary, it may be said that notable ingenuity has been shown in the devices and methods used in the study of attention. The majority of these can be grouped into (a) simultaneous disparate activities, (b) alternating disparate activities, (c) distractions, (d) rates of discrimination, (e) rates of work or efficiency, and (f) variations in limen. The last group was used before the period included in this thesis began and has, therefore, not been included here. While these devices, their measurements, and the interpretations of these measurements have been
ingenious, the writer believes that none has yet been ingenious enough to isolate the entity or the psychological factor of attention clearly and indisputably. How much of this is due to the confusion of theory and of definition, and how much to the inadequacy of experimental devices and interpretation, remains to be seen.

INTELLIGENCE AND MATURATION

Various studies have been made as to the attentiveness of children at various ages from pre-school onward to determine the degree of attention sustained—the effect of maturation on attention.

Schacter (163, p. 478-488) stated that "differences in the attentive activity of children have been noted by many observers and commentators, and various factors have been suggested as being causal elements therefor. The chronological age of the Subjects has been suggested as explanatory of differences in sustained attention. This view, holding that the older the child the longer the period of sustained attention, has been expressed by Andrus, Bertrand, Bott, Davidson, Herring and Koch, Inskeep, Van Alstyne and Woodrow."

Schacter (163, p. 478-488) further stated that "it has been indicated that the sex of the Subjects determines their attention-span, but.....there has been disagreement
as to which sex exhibits the greater attention span..... Fundamental differences in personality development have also been offered as the essentials explaining differences in attention behavior..... by Brown, studying pre-school children, and by Hovey, who used high school pupils as subjects."

"Perhaps the most frequent explanation offered to account for the sustaining of attention has been intelligence, a positive relationship being held to exist between the degree of intelligence manifested and the length of the attention span..... That attentive behavior and intelligence are closely related has been emphasized by a number of writers who considered children of various ages as their subjects."

Schacter (163) also called attention to "published results of some investigations where the measure of intelligence was objective rather than subjective and therefore a more dependable means of comparison." In the Hughes study (98, p. 482-494), a coefficient of .34 was reported to have been found between intelligence and the control of attention. Schacter (163, p. 480) also mentioned Cushing's investigation of a 'perseverative tendency' in young children in 1929, in which a correlation of .58 between the Merrill-Palmer results and the perseverative score was found.
According to Schacter's article (163, p. 480) "the varied opinions of the many writers upon the subject of attention have only too often been theories without supporting experimental evidence. The observational studies reported of child activities have been made under such diverse conditions that comparative results may scarcely be considered valid."

In view of this, Schacter refers to her previously proposed method (162, p. 339-371) "for measuring the sustained attention of young children" which has already been reported in some detail in the foregoing section of this thesis. The use of this method "with a group of thirty-six pre-school children resulted in evidence indicating that children of three, four, and five years of age show no significant differences in the time of sustained attention..... Examination of the individual records obtained indicated a consistent brief or long-sustained period of attention and suggested that some causal element or elements remained to be designated as accounting for the varied attention spans noted. It was obvious that the average attention-spans of the subjects in the two types of situations presented--simple and complex--differed; the average periods of sustained attention ranged from eight to twelve minutes, depending upon the complexity of the activity engaged in. This suggested a relationship
existent between attention-span and intelligence."

Schacter therefore made a further study (163, p. 478-488) attempting an evaluation of intelligence as a causal factor in attentive behavior. Reporting on this study, she (163, p. 481-482) stated, "To ascertain the degree of possible relationship existent, it was necessary to obtain an objective measure of the intelligence of the subjects of the experiment. No one scale or test available seemed wholly satisfactory from all aspects; where one places great emphasis upon the acquisition of language, and thus penalizes the child hesitant in the use of words, another capitalizes on the manipulative inclinations of young children and discriminates against the child who is awkward and not adept with his hands. Terman pointed out in writing of the Binet-Simon Scale that 'No single test used alone will determine accurately the general level of intelligence.'"

Schacter therefore used in her investigation (163, p. 478-488) "the composite results of three widely varying types of tests.....as the basis of comparison of intelligence with attention span. The performance utilized a verbal scale, a performance scale, and a picture-pointing test, viz., the Stanford Revision of the Binet-Simon Scale, the Merrill-Palmer Performance Scale, and the Detroit Kindergarten Test. There were thus obtained three intelligence quotients for each subject, which were averaged to
provide a composite I. Q. for each individual examined."

"The group of subjects (163, p. 483) as a whole is seen to be somewhat selected in so far as mental ability is concerned. The range of intelligence quotients is from 84 to 135, with an average of 108, and an average deviation of 7.4. A little better than forty per cent of the subjects scored at or higher than 110 in the composite results of the intelligence measurements. With a division of the group according to sex, there is to be noted a fairly even distribution for two-thirds of each section: twelve boys and twelve girls score between 100 and 115 in the intelligence test results."

Schacter also pointed out (163, p. 483-484) that a very slight difference was found between the three age-groups in her investigation in the average time of sustained attention; but that within each group there appeared marked quantitative differences in the attention processes of individual children and that, considering both simple and complex situations of the experiment, when the three approaches of each type of activity were averaged, a wide range was found to exist in the attention-span at each age-level. She further stated that, in correlating the average attention-spans with the average composite intelligence quotients, "the lack of marked relationship as shown by the correlations is striking, only the highest
coefficient, .56, showing a somewhat significant correspondence between the two factors under consideration; and further, she found "a consistently higher degree of relationship between the intelligence measurements and the time of sustained attention for the complex situations as compared with the intelligence quotients and the attention-spans for the simple situations."

In this connection, Schacter further noted (163, p. 485) that "the correlation drops off with the simple situations as age increases; in a smaller degree, the same thing occurs with the complex situations." She suggested that "this may indicate a very definite relationship between the significance of the material to the subjects and the length of time they will attend to it; simple material intrigues the very young child, but, as age increases, simple material loses its charm and only the more complex material is capable of offering a challenge."

Schacter drew the conclusion (163, p. 485) that "the low positive relationship found to exist between the sustaining of attention and mental ability indicates that differences in intelligence cannot be used to account for differences in attentive activity in individual children."

She (163, p. 485-486) further believed it to be significant "that when estimates of intelligence were used by investigators as a basis of comparison of mental ability
and attention, the relationship reported stated intelligence to be the essential factor in determining attention, whereas in those studies in which an objective measure of intelligence was used as a basis of comparison, a decidedly lower degree of correspondence was invariably revealed."

Schacter (163, p. 486) finally concluded that: "the hypothesis that there is a definite causal relationship between intelligence and sustained attention is not supported by the results of the present investigation;..... and that some factor other than mental ability is involved and must be sought if an explanation is to be attempted of the so obviously varying manifestations of attention in individuals."

In a later study made of the personality tendencies and sustained attention in pre-school children, Schacter (164, p. 313-328), in 1934, found a correlation of .67 between ratings on introversion and duration of sustained interest in simple situations, and a correlation of .74 in complex situations. These ratings were obtained by means of the Marston Personality Rating Scale. She believed that such personality differences as are revealed in her study are more important than age and intelligence in determining sustained attention.

Bestove (15, p. 368-380), in a study of attention in young children, used Schacter's experiments (162, 163, 164)
along with an original experiment of his own in which he sought to differentiate between attention and interest in activity by selecting materials that would be meaningless. He wrote that: "to render a visual stimulus meaningless, it is necessary to get away from color and pattern. For a meaningless auditory stimulus, it is necessary to eliminate melodic and rhythmic pattern. Because it is so difficult to isolate tactual, olfactory, and gustatory stimuli, they have not been included..... The omission of tactual stimuli was made with a definite purpose in view, namely to eliminate manipulation in order to minimize as much as possible the tendency to perseveration."

Bestove (15, p. 379) reached the following conclusions: "(a) There is a significant lack of relationship between the scores obtained on the visual and on the auditory situations of the original experiment.....which persists even when age, sex, intelligence, and school experience are held constant by statistical measure; (b) there is a difference in all scores between the two groups observed.....(though) there is no evidence that the score is affected by the length of time in the nursery school; therefore, the conclusion is drawn that there are other factors of more importance which distinguish the two groups..... namely, familiarity with the experimenter and with the experimental room, amount of previous experience
with the materials, and the length of time intervals between the tests; (c) there is apparently little relationship between such qualitative aspects of behavior as relevant and irrelevant conversation, form and color discrimination, and the total time score; (d) in the case of perseveration, low correlations between the total score and the number of shifts of attention indicate that there is no relationship between a tendency to perseveration and a tendency to shift the attention; (e) analysis of overt behavior and comments indicates that significant variations in behavior do not appear in a score for attention based merely upon the amount of time spent; (f) individual differences in the groups studied appeared to be of a great deal more importance than any developmental factors in determining the nature and duration of the individual's behavior while attending. The selective character of the sampling, both from the standpoint of the age range and of the number of subjects, makes it impossible to conclude that the above statement holds true for the field of attention as a whole. It does indicate, however, that developmental factors may be of less importance than is commonly supposed, and that behavior patterns exist irrespective of age, sex, intelligence or training.

Bestove (15, p. 380) further stated that "the most important single conclusion which is indicated is that
auditory and visual attention are not identical or even similar processes, and that the individual's capacity to attend to one type of stimulus is apparently in no way related to his capacity for attention to the other. The practical considerations which are involved, could this conclusion be shown to be true, are of the greatest importance. Attention in education has largely been thought of as a unified process. If, however, it differs with the different senses, all material for learning should not be presented in the same way, and adjustments to individual facility might bring about a greater increase in the ability to learn. The assumption that individual differences far out-weigh such factors as age, intelligence, and training, would indicate a need for the revision of the norms and standards in learning which are based upon age and training factors."

Gutteridge (82) reported observations of the play of 417 children, aged two to five years, made by nursery school and kindergarten teachers, from which it was found that "power to attend increased year by year." The average length of attendance was 9.4 minutes for two-year-olds, but this increased to 23.8 minutes for five-year-olds. The relation of attention span to sex, intelligence, temperament, home care, health, and origin of the activity engaged in, were determined. On analyzing the play
activities in relation to age, this author (82) found the two-year-olds spending large periods of time in activities providing opportunity for muscular effort of the large muscles. This interest then waned until, at five years, there was more interest in expressing individual ideas through various media such as sewing, carpentry, and block building. The author cautioned that children should be allowed ample time and opportunity to complete these natural attention periods. He further stated two educational implications: (a) that habits of attention can be well established by the age of six years; (b) that preschool children are chiefly interested in activities related to real life industries of home and community, so play materials of that type should be furnished them.

Marzi (121, p. 388-391), administering the Toulouse-Pieron Attention Test to 600 students, between eleven and twenty years of age inclusive, in an industrial school at Florence, found that the error curve was practically constant for these ages, although the speed curve (using the time of finishing the test rather than the work done in a given time) showed a constant and very remarkable increase from eleven to eighteen years, the time being reduced by half. After eighteen years of age, these values were constant. Marzi concluded from this that the progression with age so demonstrated, insofar as it concerned
attention, was due to an increase in reactive capacity.

Harris (86, p. 480-484) made a study of the overt attention in young children during clinical examinations, the purpose of which was two-fold: "(a) to determine whether a quantitative method of recording shifts in attention during a routine clinical developmental examination was practicable; and (b) to study individual variations in overt attention shifts in an effort to determine whether personality factors are of primary importance or whether certain modes of attention are characteristically found in children of similar age or of similar intellectual status. By overt attention is meant apparent direction of the interest of the individual."

Harris (86) outlines the experiment and its results as follows: "The records were taken during routine clinical developmental examinations so that the situation was relatively well controlled. Only one child at a time was present. The observer was seated behind a one-way-vision screen near enough to see the child clearly and to hear all that was said, but herself unseen. The child was seated at a table about ten feet from and facing the observer. The timing device used in making the records consisted of a Becker time-marker mounted like an earphone, which ticked in the observer's ear every second. A check for each child could be made on a paper fastened to a clipboard without
the removal of the observer's eyes from the subject. A time-sampling method with five-minute intervals was employed. An average of three records was made of the child...."

"The group used for study was a heterogeneous one. Records were made of twenty-nine Subjects, fifteen boys and fourteen girls. The age range of these Subjects was from thirteen to sixty-one months, with a fairly even distribution."

"The classifications obtained from the clinical records ranged from defective to superior with the largest number of Subjects falling in the average group. Although the number of cases was not large, it represented a sampling of children examined by the clinical service--17 dependent, 6 with mental or physical defect, 3 behavior difficulties, 3 follow-up studies...."

"For purposes of comparison, the records were chronologically arranged in age groups of six-month intervals. Graphs were made of those attention categories which occurred most often, viz., the total percentage of attention to the test objects, of gross motor activity, of refusal to perform, and of play use of material. The attention total showed more variation and was lower at 18-36 months than at any other time. At 18-24 months, this decreased attention was accompanied by a marked increase in
motor activity..... Refusal to perform was low at all levels with marked variation on a few records. Play use of materials reached its highest level during the 18-24 months' period and showed a slight decrease in the upper age levels. The amount of talking or vocalizing and the number of attention shifts were also studied but showed no special age differentiation."

"A rearrangement of the records according to the reason of reference of the child to the clinic resulted in three groups--dependent children, children with physical or mental defects, and children who were brought in for guidance or checkup examination." Certain characteristic tendencies seemed to apply to these different groups, according to Harris (86): "the motor activity was practically the same for all of them. Refusal to perform appeared most consistently in the dependent group. This group also exhibited a greater amount of passive resistance, staring at the examiner or materials instead of performing as instructed. Play use of materials was most prominent in the group of defective children. The guidance group was characterized by greater freedom of speech....."

"That the dependent children were more negative, the children with behavior questions more freely talkative, the defective children more rigidly persistent in playing unadaptively with the test materials--was corroborated by
comparison with the clinical records. Though the findings apply only to this particular group, the fact that there is correspondence between these and other findings in the study of the same children is an added reason to indicate that this quantitative method may be an aid to further study of the phenomena of attention in clinical situations."

A previous study made by Bridges (25, p. 551-570) in 1926-1928, covered the occupational interests and attentions of four-year-old children. The study was conducted at the McGill Nursery School during two sessions and was confined to three-year-old children during the session of 1926-1927, and to four-year-olds during the 1927-1928 session. This report (25, p. 551-570) especially covers the study made of the four-year-olds. "In both studies, observations were made on the nature and duration of the occupational interests of a group of children, with a view to finding which of the occupations provided appealed most to the children, and whether there was any sex difference noticeable in preferences for certain occupations. It was also desired to find out how long an interest in one occupation usually lasts, how long it may last on an occasion, and whether there are any sex differences in duration of interest in one occupation. In addition..... it was hoped that the study of the four-year-olds might be a slight
check on the study of the three-year-olds. There were so few children in either group that individual differences might greatly modify the group results."

Bridges (25, p. 551-570) stated these conclusions: "The findings in this study of 14 four-year-old children corroborate to some extent the findings of a previous similar study on 10 three-year-olds, six of whom were the same children. In both cases, certain occupations were found to be more popular than others. Among the favorite occupational materials were those of a colorful nature which presented self-evident problems within the scope of the children's abilities, and yet which allowed opportunity for variation. Montessori cylinders and cubes were popular with both year groups. There were, moreover, slight sex differences noticeable in both studies in the choice and duration of occupational interests....."

"The boys showed a preference for the inset-tracing and cube-construction, while the girls preferred the dressing frames. Thus the boys seemed to prefer less definite occupations which could be made as simple or elaborate as they chose, and which involved hand and arm movement rather than fine finger manipulation. The girls, on the other hand, seemed to prefer definite tasks of shorter duration which involved following directions and careful finger movement. The girls, moreover, showed somewhat more diversity in
their interests than did the boys. There was a noticeable tendency on the part of all the children to choose the easier occupations...."

"The usual time the children in this study spent at one occupation was about six minutes. This is possibly more indicative of the length of time required to complete the more popular of the occupations available than the length of time four-year-old children may be expected to stay at one occupation..... The boys usually spent about 10 minutes at one occupation, while the girls spent only 5 or 6 minutes....."

"The three-year-olds in the previous study usually spent about 8 minutes at a single occupation, that is, slightly longer than the time spent by the four-year-olds. This difference may be accounted for in whole or in part by the difference in the conditions of the two studies. The similarity in the above results is, however, more striking than the difference, and seems to indicate that pre-school children when left to choose their own time will spend only 5 to 10 minutes at one occupation."  

"There were fewer occasions when the three-year-olds spent over 25 minutes with one set of materials than was the case with the four-year-olds. The longest time given to any occupation, however, was much the same for either group, about 35 minutes..... In both studies the longest
duration of an interest was a little greater for the boys than for the girls."

"In the study of four-year-olds, it appeared that, although the boys stayed longer as a rule at one occupation, they were distracted a little oftener than the girls. It was interesting to note also that they talked more frequently than the girls. They usually worked about two minutes between distractions while the girls worked for nearly three minutes between breaks. Distractions were for the most part distributed evenly over the observation periods. The girls, however, showed more tendency to distraction during the middle of the period than did the boys. These results, however, are subject to a large experimental error which makes them of doubtful significance."

"It should perhaps be mentioned that none of the sex differences referred to in this article were very marked. It is quite possible that in all cases they were due to the particular selection of children under observation. On the other hand, they may indicate differences between boys and girls in general. If they do, it would still remain an open question whether they were due to original nature or to home influence."

Along this same line of investigation, Thompson (188, p. 165-188), in 1943, reported the results of a
ten-year study of the play behavior of a pair of identical twins, with special reference to attentional characteristics, from the time they were forty-two weeks old until they were ten years of age. Quoting Thompson, "Their play at each age was found to be so similar in interests, and in tempo and type of activity, that, observed separately, it would have been difficult to identify one twin from the other; but when the records were comparatively studied, slight differences in attentional characteristics were found to persist from age to age."

"By the time the twins were three years old, these differences were recognized as being relatively fundamental..... We wondered if they could be modified by training. Observation and testing were continued in order to understand the nature of the dissimilarity. Finally, when the twins were 3 years, 7 months of age, an experimental training schedule designed to alter their behavior traits was planned....." Summarizing the experiment, Thompson (188, p. 187-188) stated: "By the method of co-twin control, T, one of......the twins, 3½ years old, was trained to channelize her activity, to play continuously with the toy of her choice. She was given 25 training periods, usually two a week, over a period of four months. Each period lasted 45 minutes. Her co-twin was simultaneously exposed to duplicate toys in a duplicate room, but
her play was undirected."

"Scores on the Cushing Test of Perseverative Tendency, the number of toys played with, the timed records of free play, before and after training, indicated that in comparison with her co-twin, T's behavior had been modified; she learned to play with the toys in a specified way; and her area of attention showed restriction. But within the restricted area, her characteristics of attention relative to those of her twin remained as before; she continued to play with the toys more discretely, to shift her activity sooner, and to resort to physical activity to a greater extent than her co-twin.... The effects of training did not persist when the twins played together and were no longer in solitary play nine months after the training ceased. After six months of kindergarten experience, no effects of the experimental training were observable."

Thompson (188, p. 187-188) stated further that "incidentally the study indicated that: (a) Merely to supply toys to the pre-schooler is not enough; If children are to utilize the toys, demonstration and help in their use is necessary; (b) Play can, however, be overorganized so that it is merely routine performance; (c) Undirected play activity fosters the development of phantasy and imaginary play which are important from the viewpoint of creative activity and emotional outlets."
The principal conclusions which Thompson (188, p. 187) drew from this investigation are stated as follows:

"(1) Play behavior characteristics may be used to study attentional characteristics; (2) The duration, variation, and tempo of the focus of attention in unrestricted activity are fundamental and individual characteristics which persist from age to age; (3) The scope of attention can be restricted by training; (4) An individual may give evidence of being disturbed by this restriction in scope if training is prolonged; and (5) Even though modification in scope may be imposed by training, the individual tends to revert to previous attention patterns in a relatively novel situation."

Wilson (205, p. 498-504), in 1930, reported the results of a study of the factors of repetition and of directed and undirected attention in the learning of bright and of dull children, in which twenty-six Gregg shorthand characters were presented in the form of the game "Duck-on-the-Rock." Words were typed on a 4 by 6 card, with the shorthand character for the word directly above it. "The experimenter pointed to each character, telling the Subject that it stood for the word directly beneath it, directing him to pronounce the word and to be sure and look at the character. After each such practice, a test was made by presenting the subject with a card upon which appeared the
same characters without the words, and arranged in different order from that on the practice card; the Subject was then asked to indicate and name the words for the characters he knew or thought he knew." During a series of seven practices distributed over five successive days, a record was made of the number of correct recognitions.

The data seemed to indicate that repetition, "at least repetition within a very brief period of time was of uncertain value in making the reactions easier"; and that "spaced practice, as much as 24 hours, seemed to equalize the effect of two or three repetitions at the time of a given practice period. It seemed also, that directing attention in the detailed manner of the experiment had little specific effect....."

In summarizing the applications to be drawn from this study, Wilson (205, p. 502-503) stated: "Understanding the processes involved in this or in any learning task must go much deeper than consideration of repetition, directed attention, difficulty of units and such factors, which, although of great importance in the guidance of the learning processes, are in most cases quite accidental, superficial and temporary..... Learning experience is a unitary affair proceeding in a moving, ever-changing situation, in which the essential process may be called the reconstruction of experience.....taking place."
Wilson (205, p. 503) concludes as follows: "It seems, then, that teachers, parents, or others interested in the guidance of children should give consideration to two simple conclusions in regard to learning, namely: (1) Learning is furthered by seeing that orientation toward the work --interest, effort, and understanding--is secured; (2) Learning is furthered by seeing that wide, full, broad experience with numberless specified items is afforded. There is every reason to believe that these phases of learning are as advantageous to the so-called dull children as to the so-called bright children."

Hummer (99, p. 116-121), in 1931, experimented with 107 persons (normal school children and adults of both sexes with and without secondary education) by having them write previously practiced signs as fast as possible during one and one-half minutes while counting aloud the strokes of a metronome. She concluded that ability to divide the attention runs in a general way parallel to the grade of intelligence, that psychophysical energy is one of the factors which constitute intelligence, and that the ability to divide the attention develops, at least in girls, up to the thirteenth year, but not afterward.

Blonsky (19, p. 22-26) made an interesting experiment to determine whether the alkalinity of the saliva might be an indicator of the intelligence and of the mental
concentration of attention. "The saliva of 412 Moscow school children (207 boys and 205 girls) was tested first before breakfast, and the results were computed statistically to determine norms for age and sex. In 73 cases marked deviation from the average was found. From these were selected 12 pairs identical in age, sex, and nationality, but differing in alkalinity of saliva. These were tested with the Burt Revision of the Binet Test. The children with more alkaline saliva proved in every case to be more intelligent. The more intelligent children also showed greater respiratory capacity. A series of tests performed with ten children who were required to concentrate attention upon the solution of different maze problems showed that during voluntary attention the alkalinity of the saliva is increased. A third series performed with six children who were asked to daydream for ten minutes about any object that gave them pleasure, showed that the alkalinity of the saliva decreases during reverie. In fact, in half the cases the saliva became definitely acid."

Leontiev (113, p. 52-83), in approaching a mechanistic interpretation of voluntary attention from the socio-genetic angle, experimented to observe the development of voluntary attention in the child by means of a game conducted with Subjects of different ages in which "the
Subject was required to answer various questions after having been previously instructed not to name certain colors, not to repeat any, etc. In the course of this, he had before him a supply of colored cards including the forbidden colors. Pre-school children proved very distractible and could not use the cards as external stimuli to help them follow the rules of the game; school children used the cards as definite external aids; adults followed the rules with less use of external aids."

In summarizing the results of his experiment, Leontiev (113, p. 79-80) stated: "The development of a child's attention is not confined only to the development of its primary biological forms; but includes the transformation of these elementary forms into new and higher forms. The child's attention, which at first is involuntary, i.e., depends directly on the action of stimuli, is transformed in the process of its development into the voluntary attention characteristic of the adult. This process of transformation takes place on the basis of the control of the child's attention from without, with the help of external stimuli. The child, feeling the effect of these external stimuli on himself, and, learning in his turn to react on others around him, becomes capable of using external stimuli with the idea of organizing his own behavior. By thus controlling stimulation, the child controls his own
attention; by submitting to the natural laws of his own behavior, he thus makes the latter submit to him, and in this sense transforms it into voluntary attention...."

"Children of early pre-school age prove incapable of actively using external auxiliary stimuli as a means of organizing their own behavior. The attention task is fulfilled by all the children in exactly the same way, both in the series of experiments without auxiliary means and in the series in which the child is called upon to use definite auxiliary means. In early school age, however, the child learns to organize his behavior from without, with the help of external stimuli, and the differences in the indices of these two series of experiments reaches its maximum. With the transition to a more advanced age, the role of external means in organizing behavior becomes less significant. The function fulfilled by these external means gradually passes over to the internal elements of the experiment. What takes place now is emancipation from the external forms of the stimuli which were at first indispensable. The external signs of the operation are transformed into internal signs. In this way the development of the voluntary attention of the child should pass through a stage when his behavior is controlled with the assistance of external stimuli-signs, which are subsequently replaced by internal signs."
James (101, p. 418), in 1890, covered much of this material at least as well as many of the later writers. He wrote that childhood was characterized by great active energy and few organized interests with which to meet new impressions and to decide whether or not they were worthy of notice. The attentions of children are extremely mobile. In mature age, one has generally selected those stimuli which are connected with one or more so-called permanent interests. One's attention is generally unresponsive to the rest. These permanent interests are grounded in certain objects and relations in which one's interest is immediate or instinctive.

James further wrote (101, p. 423): "Geniuses are commonly believed to excel other men in their power of sustained attention (duration). It is their genius making them attentive, not their attention making geniuses of them. They differ from ordinary men less in the character of their attention than in the nature of the objects upon which it is successively bestowed. In genius, these form concatenated series, suggesting each other by some rational law; hence, one calls the attention 'sustained' and the topic of meditation for hours 'the same.' In the common man, the series is for the most part incoherent, the objects have no rational bond, and one calls the attention wandering and unfixed. The faculty of bringing back
voluntarily a wandering attention over and over is the root of judgment, character and will. An education which improves this faculty is 'the education par excellence.'" James adds, with a wry sense of humor, that this is easier to define than to bring about.

**Summary**

While one author has stated that the power of sustained attention among young children is not closely related to intelligence, she found the relation closer when the children were doing complex tasks than when doing simple tasks. Another author found, on the contrary, that sustained attention is closely related to age and suggests that attention ages, similar to mental ages in conception, be developed. Still another author wrote that attention changes from the purely involuntary attention of infancy to the more predominantly nonvoluntary form with maturation.

Introversion and extroversion were stated to be more closely related to attention than intelligence is, although these concepts have largely been abandoned. Another writer found that visual attention and auditory attention were frequently widely different, and recommended that the most important classroom material be presented in both ways in order to impress it more deeply and to give the pupils using predominantly the one or the other equal.
opportunities to learn. It was found, also, that dependent, defective (mentally or physically), and those children who are pre-delinquent, attend differently.

Concentration of the attention was found to increase the alkalinity of the saliva, while daydreaming was found to decrease it.
VALUES AND APPLICATIONS

The possibilities inherent in a learning situation in which the attention of the student is definitely directed have been given some attention by various writers.

Sengupta (168, p. 115-118), in 1929, made an "experimental study of definitely and indefinitely directed attention" from which he concluded that "different sets of psychological factors are in operation in the cases of definitely and indefinitely directed attention. The former method gives twice the efficiency of the latter in a simple learning experiment."

Musatti (138, p. 137-151), in 1947, experimenting to determine the functions of attention in the performance of a uniform task of selection, approached the problem of interpreting results from a qualitative and quantitative point of view through a statistical analysis of the performance on the Toulouse-Pieron Test, administered to 886 Subjects. According to the abstract given: "this analysis indicates that subjects who can depend on automatic performance reach a high speed; subjects who depend on active recognition of critical signs are slow. A good performance requires two different abilities: negative selective attention (items not to cancel) which makes for a high quantitative score, and positive selective attention
(items to cancel) which makes for a high qualitative score. For the purpose of selection in industrial psychology, the two scores should be weighted according to the task to be performed."

In an earlier experiment conducted by Krueger (109, p. 517-527), three groups of Subjects each learned lists of paired associates under various conditions of directed attention. Attention was directed by means of red or black lines under the pairs of nouns. For each condition of learning, one list had the middle section underlined in black and another list in red. The same lists were used by the control group, to which no directions of attention were given. "Directed attention brings about more economical learning than non-directed effort. Learning values of such direction are the same regardless of whether the first, middle, or last part of the unit to be remembered receives the directed effort."

Kindler (105, p. 179-302), in a study of the conditioning factors and the possibility of training attention, used the Bourdon Test, which he modified to suit his special purposes, in group and in individual testing, the tests being graded as to extent and quality. After the test, the testees recorded their own mental reactions and processes. His findings were (1) the wish to remember well is necessary to remember well; (2) the deciding factor for
the extent and the quality of the result is not the vividness and clearness of the desired reaction, but the automatization of this reaction; (3) training in appropriate psycho-technical matters has an effect upon results depending upon attention; mere repetition without change in methods does not improve the results; (4) continued visualization is detrimental; (5) there is a pronounced positive correlation between good results in the Bourdon Test, on the one hand, and typing, adding, and copying in professional life, on the other. The person with only average intelligence gets the best results. There is a negative correlation between the Bourdon Test and intelligence above this average, probably due to personality traits and to dislike for monotonous work.

From the foregoing, it would appear that any learning situation would be improved if the student's attention is definitely guided and directed; but, according to Vygotski (199, p. 112), active attention should be developed long before the student enters school, his postulate being that "attention is the result of the socio-cultural process of a child's growth" and "that signs direct, stimulate, and support attention." He made observations on normal, deaf-mute, and retarded children, using three series of tests. In the first series, an attempt was made to ascertain the role of attention and its function in the process of
structural connection and the actual choice based on this connection. The second series was based on the arousal of attention and its distractions in the process of primary action and response. The choice of plurality was based on the selection of separate elements. The third series dealt with the analysis of the concrete process of active attention. The choice was based on separate elements by the aid of auxiliary stimulus means. The author concluded that active attention is a significant function based on the use of signs and attempted to explain his theory from the point of view of social genesis.

In connection with Vygotski's conclusion (199) that active attention is a significant function based on the use of signs, it is interesting to note Kohler's laboratory experiment (107, p. 210-213) in the lessening of idle machine time in the industrial field by attention-attracting markings from which he advised the use of markings on the ends of spools in the textile and wire industries as an aid toward decreasing the time during which spools are idle due to breakage or lack of thread.

Pastore (146, p. 457-475) would place much of attention on the basis of personal and social need; for example, the hungry person's attention to food. He believed that experiments on attention up to the present time have had methodological and statistical flaws serious enough to
vitiate conclusions and theories based on them. He believed that the postulates may be correct, but that better experiments are needed to substantiate them.

School

Arndt and Husband (7, p. 371-378) contended that the "obvious place to commence a defensive program against inattentiveness, that is, to start development of more conscious and discriminative listening processes is in the school; that the need lies in the development of critical listening, not just in the development of (casual) attentiveness to what is being said." They stated that "efficiency of classroom listening largely determines the amount and the character of the learning done; and the effectiveness of classroom learning is directly conditioned by the skill and the attitude which the pupil brings to the listening situation." They further stated that while development of abilities to speak, read, and write, are provided for traditionally in the curriculum on primary, secondary, and college levels, no provision is made for the development of ability in listening. They referred to a study which showed that the average American adult spends 9 per cent of his time in writing, 16 per cent in reading, 30 per cent in speaking, and 45 per cent in listening; but there are few or no studies on the quality of the listening.
This indictment of the schools for failure to train in listening finds further support in the contention of Arndt and Husband (7, p. 371-378) that "at the college level, failure of the lower schools to train pupils in effective listening reveals itself on registration day--since college teachers are almost wholly oral. College students therefore select courses on this basis: the professor must be entertaining and must be simple. This shows complete absence of any evaluation through listening done by the student."

Adams (1, p. 209-211), in referring to the 1926 Survey by a Committee of the National Council of Teachers of England which points out the four aspects of the teaching of English--writing, reading, speech, and listening--posed a pertinent question as to what has actually been done in the field of listening in the years since the report was made. He also referred to a study by Rankin (152, p. 177-179 and p. 417-420) in which he showed that listening ability is by far the most frequently used ability in communication in everyday life situations; yet, in the schools, the time used in study (on the elementary level) gives the least emphasis to acquisition of listening ability; e.g., while listening is used in life three times as much as reading, in school it receives less than one-sixth as much emphasis.
Adams (1, p. 209-211) further took the position that "speaking and listening cannot be separated. Probably all teachers would agree on this point, but they focus attention on the teaching of speech and apparently assume that skill in listening will be somehow acquired.... The development of good speakers.....may well proceed by giving time to the development of intelligent listening."

Arndt and Husband (7, p. 371-378), in their plea for the need of developing attentive and critical listening, point out that "one of the most important results of the inadequacy of our listening involves effects of indiscriminate habits of listening to radio and talking pictures. Psychology recognizes the effects of exciting programs on smaller children; the effect on the typical adult and adolescent is no less important." The implications are clear: lack of training in attentive, critical listening can well bear fruit in the public's susceptibility to propaganda, radio advertising, or other vocal means employed to sway public opinion.

Miller (135, p. 105-118), as a school counselor working with eighth grade pupils who were about to enter high school, made a study of the effects of various amounts of radio listening while studying upon ability to read as shown by scores on a standardized reading test. The results of this study showed little or no difference
apparent in efficiency of reading-type study ascribable to the presence or absence of a radio while studying.

In school situations, teachers are often urged to do everything possible to motivate the children, and are blamed for not having done so if the children do not seem to be progressing as they should. As a result, many teachers employ various novel, exciting, or otherwise stimulating devices to attract and, possibly, to hold the children's attentions while the point of the lesson is, it is hoped, being "driven home." While the children's attentions may be held in this manner for the time being, at the same time, they are getting the idea that they are in school to be entertained. The question therefore presents itself, "Would not more emphasis placed on teaching the children better ways in which to listen and to evaluate, from the elementary level on up, perhaps, result in developing a genuine interest on their parts so that, as they grow older, they will have so formed the habit of evaluating what they hear that they will more readily be attentive in the classroom in order to make such evaluations?" In this way, there might be less necessity for the employment of novel devices to attract and hold attention, even though such devices may at times have their places, and may serve worthy purposes.

Schmidberger (165, p. 392-397), after examination of
the school marks of more than two thousand German school children in 1931, concluded that girls show a constant superiority over boys in attention and in application—even in Germany.

Hunnicutt (100, p. 620-624), in an article dealing with various skills which may and should be developed early in the child's life, listed concentration (paying attention) as the second major skill which should be started early, and suggested that the first grade provides ample opportunity—one group in the oral reading circle, others having their appropriate occupations meanwhile, but subjected to a continuing barrage of verbal distractions. He wrote: "Adhering to a task despite distractions is easy if one is more interested in the task than in the distractions..... hence, if children participate in planning their tasks and have purposes consonant with them, they are likely to be more interested and less susceptible to distracting influences; better able to build a habit of immunity.....and teachers can encourage them to resist distractions through self-discipline."

"Recognition that concentration (100, p. 620-624) is successful resistance to distracting influences suggests two lines of action: (a) selection of places of study that offer few distracting stimuli, and (b) learning to minimize the influence of those stimuli that do remain..... Internal
distractions, such as nagging fears and worries, are likely to be more difficult; and it was suggested that, by taking time to analyze such distractions, finding out whether there is anything to be done, and making the proper plans for acting--such as deciding where one may go for help--or, if nothing can be done, clearly recognizing the fact: such procedures may bring a certain relief from worry and free the pupil so that he may go back to the task at hand and bring all his attention to it. Hunnicutt concluded (100, p. 620-624) that all the foregoing emphasize the fact that "concentration is not simply an innate gift which one person possesses and another lacks. It is a definite skill that can be taught and learned directly in a manner analogous to arithmetic or tennis."

Applying this concept of concentration to the acquisition of a definite skill, McGill and Smith (127, p. 72-74) wrote: "If we would only use what is known about our nervous systems in our typing classes, we could increase greatly our students' ability to concentrate uninterruptedly. Optic nerves, auditory nerves, and nerves from our association (thought) centers carry pictures or "word patterns" to the brain. In the learning stages of every simple and complex response, the brain translates these received impulses into deliberate action through the medium of outgoing impulses transmitted to other parts of the
nervous system, to the eyes, arms, hand, and fingers...."

"As the typist becomes more skillful and masters certain hierarchies of thought and motion, incoming and outgoing impulses are short-circuited.... Attention then turns to other and more important details of the complex responses and to the maintenance of a steady flow of typing operations."

As each obstacle to smooth, unfettered, speeded operation appears, the typist must be able to think of the right thing at the right time, changing his pace as needed in order to conquer each obstacle, and changing it again to get back to his maximum operating rate, all without upsetting his mental stance and control. The concentration needed here is quite different from what is needed in the earlier stages."

"Typists in general, and particularly beginning typists, sabotage their own work by making themselves believe they are concentrating properly, when really their minds are on something else entirely; such as 'I must not make an error' or 'there is only one more minute to go.'"

"Such distracting thoughts only mislead the student and make him believe honestly that he is concentrating wholly upon his work, when in fact.....his concentration is not on the copy or on the direction of his specific mental and physical responses; rather it is on a thousand and one
extraneous matters that naturally intrude to disperse his mental and physical energy and make his effort unfruitful."

After outlining some simple rules for concentration to be applied to the acquisition of typing skill, McGill and Smith (127, p. 72-74) concluded with the following: "Proper concentration calls for a certain ambivalence or readiness and ability to change the direction of the attention from one essential thing to another and to still others, as the typing operations require, always shutting out, as effortlessly as possible, extraneous ideas and sense impressions. Continuous concentration of the right kind will produce a relaxed, steady, and confident typist."

Brueckner and Ladenberg (28, p. 370-373), in a study of the "Frequency of Checking Attention and Reliability of the Attention Quotient," raised the question of whether it was necessary to make a count of pupils who were actually paying attention in the classroom each minute (Morrison's method) or whether an attention quotient based on 2-, 3-, or 4-minute intervals might yield as reliable an index, thus allowing the observer to record other types of information as well. After applying Morrison's method in which one observer made a detailed record of pupils not at attention at each 1-minute interval, the data were analysed as follows: (a) the attention quotient was computed according to the Morrison plan; (b) the data for 2-minute
intervals for the same class, was secured by consolidating the results for the 1-, 3-, and 5-minute intervals and likewise for the 2-, 4-, and 6-minute intervals. It was thus possible to compare the two sets of facts for the same lesson, based on data for 2-minute intervals. Similarly, data for 3-minute, 4-minute, and 5-minute intervals were computed. The observations were made of complete recitation periods in a wide variety of classes and subjects (records for seventy-eight classes in Junior and Senior High Schools).

The conclusions reached were that, in most classes, the supervisor or principal may get a reasonably reliable index of attention by making a record of attention at intervals of not longer than four minutes. The results secured from intervals of 1-, 2-, 3-, and 4-minutes are practically the same. The variations when 5-minute intervals are employed is large enough to warrant the recommendation that intervals of such length probably should not be used. Obviously, the more frequently the checking is done, the greater the reliability of the quotient for the class. However, for all practical purposes, a 3-minute interval will give reliable data. For intensive diagnosis of classroom difficulty, a record based on intervals of one minute should be used, paralleled with notes as to what is occurring when attention seems to flag. In this
same study (28, p. 370-373), the authors made the statement that "the degree of attention of a class of pupils is commonly regarded as an index of quality of instruction"; but they also say that "we do not know how large a difference in class quotient represents a difference in teaching skill."

Shannon, in later studies (170, p. 623-631) (171, p. 49-52) made in 1941 and 1942, conceded that Morrison's device for evaluating instruction by means of attention scores is reliable; but contended that its validity has not been equally well established. He expressed his doubts in this manner: "That certain external evidences of attention may be regarded as valid indications of attention errs in the implication that mental states have standardized objective physical concomitants. A child may be attentive to all that is said, but still sit languid with his eyes closed, or look out of the window. Also, he may follow every movement of the teacher with his eye, but have his mind on her dress or physical appearance." Shannon further quoted similar doubts from Henzlik (93, p. 226-230), and finally concludes that "the evidence is damaging to the validity of attention measurement. That it has a slight degree of validity is clear, but that it has enough validity to warrant its use in judging classroom activity is worse than doubtful. One might say that this conclusion
should have been obvious without the experiment, but evidently Morrison did not think so."

Edmiston and Braddock (54, p. 665-672) made a study of the effect of various teaching procedures upon observed group attention in the secondary school in the following manner: Trained observers watched the pupils in twelve schools during classes, recording their attention each minute of the class period (Morrison plan). Nine different teaching procedures were used: student reports, demonstration, general discussion (student dominated), general discussion (teacher dominated), workbook, lectures, rapid-fire question and answer, and laboratory. It was found that mean attention scores (percentage of students attending) ranged from 80.60 ± 9.00 for the laboratory procedure to 88.20 ± 7.73 for the student report procedure. It was concluded that the procedure which presents the best combination of the following attributes should produce the best attention: appropriateness to the learning situation, student participation, thorough previous preparation, definiteness and clearness of assignment given to the pupil, and combined visual and auditory learning.

Prengowski (151), in his book, *Concept, Judgment and Attention*, sought the relationship which exists between judgment and attention. He examined concept, judgment and attention conjointly because of the close bond that exists
in regard to these three psychological phenomena, and especially because of the fact that work on each of these phenomena is closely linked. The necessity for training in ability to attend is not to be applied to the school learning situation alone, but has its applications reaching on into the adult life of the individual, and into his daily employment in whatever walk of life he may find himself.

Gatti (76, p. 188-195) described a situation in which tests of arithmetic were given to a class in an artificially disturbed work situation in order to examine the influence of the environment on the capacity for concentration of attention. The influence of the disturbance was manifested in two ways: (1) a digressive effect on one group of pupils, diminishing the capacity for concentration of attention, and (2) an exciting effect on the other group, increasing the capacity. The author pointed out the importance of accustoming pupils to work in artificially disturbed situations similar to those which are probable in future employment environments.

Simon (172, p. 29-48) proposed two psychological problems in vocational guidance: (a) the relation between general intelligence on the one hand and attention on the other; and (b) the relation between objective and subjective measures of intelligence for vocational guidance purposes. Using the Otis Test of Mental Ability and the
Toulouse-Pieron and the Kraepelin Tests of Attention, he obtained a correlation of plus .69, with 205 cases. He concluded from this that indices of attention may be used as measures of intelligence in guidance situations and that the use of standardized tests may be abstained from when their use is inconvenient.

Mata (124) also attempted to relate attention to psychotechniques with respect to professional orientation and selection, showing the importance of the individual testing of attention in relation to human labor and giving a table classifying forms of attention. He took up the question of rapidity of accommodation to a given task, promptness of perception (discrimination), and an index of fatigability. He described various laboratory methods and techniques, including his own test, which have been in use for a number of years in examinations on orientation and occupational selection, and indicated that fatigue of attention and the hygiene of attention should be of special interest in determining occupational aptitudes.

Christiaens (41, p. 1-8) made a comparison between the results obtained from a group of adolescents and those from a group of experienced adult workers (typographers, mechanics, draftsmen, and bookbinders) for different attention tests (Bourdon, Toulouse-Pieron, Ferrari, and Glazof), and concluded that "among professionals, there is a kind of
specialized attention which has not yet appeared in the adolescent, and that attention should be measured, therefore, by tests which offer a certain analogy to their occupations."

Advertising

In the field of advertising, a great deal of work has been done towards determining various means of attention-getting and attention-holding, and many studies have been made to determine the effect of adjacent distractions, such as nearby cartoons, on the attention-holding power of the advertisement itself.

Karslake (104, p. 417-440), in an article in 1940, described the Purdue Eye Camera as a reliable method for photographing eye-movements—a method which permits the use of a variety of material with unrestricted vision, the placement of the material at the distance of most distinct vision for the reader, and which also permits the reader to leaf through the material.

Karslake (103, p. 529) made a comparison of two methods of investigating the attention value of advertisements, with the following results: "Using the Purdue Eye Camera, an investigation was made of the attention value of a number of advertisements precisely as they appeared on publication in the *Saturday Evening Post*. In
this investigation, a study was made of the eye behavior of 100 people while they were in the act of leafing through the pages that were of interest to the investigator. Previous work had shown the method to be reliable and valid, with coefficients of reliability and validity ranging from .96 to .99.

"The correlations between attention value as disclosed by this method and the results of a nationally known questionnaire type of survey ranged from .14 to .42--values so low as to indicate that the two methods did not yield measurements of the same thing."

"A trial survey of the questionnaire type, using a group of 143 people, gave evidence to indicate that the questionnaire method yields an evaluation of a number of advertisements appearing as part of a series, while the results obtained with the Purdue Eye Camera are an evaluation of specific insertions of copy."

"McNamara and Tiffin (128, p. 524-527) found it possible, by using the Purdue Eye Camera, to photograph the time spent upon each advertisement and specific part of the advertisement by a reader leafing through a magazine, and to evaluate objectively the effect of cartoons adjacent to the advertisements upon the attention-holding power of these advertisements. The experiments proceeded as follows: Various groups of men and women readers from an
industrial city were asked to leaf through a recent issue of the *Saturday Evening Post*....obtained two days prior to newsstand release, in order that the readers might have had no opportunity to see the magazine prior to the experiment. Four groups looked through the magazines: Group 1, magazine unaltered; Group 2, magazine altered by blocking out the cartoons near certain advertisements with printed material similar to the copy appearing around the cartoon; Group 3, magazine altered by interchanging certain advertisements and cartoons from the left to the right page, or vice versa; and Group 4, magazine altered by blocking out cartoons near certain advertisements and changing advertisements from left to right page or vice versa."

"The reversal of left-hand and right-hand pages was not essential in studying the effect of cartoons, but was held to be necessary for certain other parts of the investigation..... One hundred-and-twenty readers were used in the experiment, but since each reader was allowed to see a given advertisement in only one of the four situations mentioned above, no single group contained more than thirty-five readers." The results were: "Of the ten situations studied, nine showed a definitely greater average time spent by the reader upon the advertisement when the adjacent cartoon had been eliminated than when the cartoon was present as it appeared in the normal issue of
the magazine. The averages show that, for the five advertisements studied in ten positions, the average time spent with the nearby cartoon present was 2.94 seconds, whereas, when the cartoon had been eliminated, this average was raised to 4.54 seconds. This difference of 1.60 seconds, or 54 per cent, is 4.4 times its standard error and, hence, is significant from a statistical standpoint."

"It should be emphasized that this study (128) deals only with the effect of cartoons upon nearby advertisements when all other factors are held constant. It is likely--indeed, perhaps certain when one considers the reader preference for cartoons--that a scattering of cartoons through the advertising section of a magazine increases the reader 'traffic' through this section. This increase in traffic probably results in a net gain for the advertisements considered as a group. But when the traffic is held constant (as in the experiment) those advertisements which happen to be on a spread which does not contain a cartoon seem to be in the preferred positions."

White and Dallenbach (203, p. 175-179) studied relation of eyedness and handedness in regard to position preference of material in receiving attention. They concluded that neither was significant within itself, but that the underlying neurological basis influences position preference. They believed that position does influence the clearness
and the vividness of material to be read and thus attracts or repels attention. They also found that right-handed Subjects were predisposed to look more to the left and left-handed Subjects to the right.

Brandt (20, p. 529-530) experimented in the field of ocular photography to determine attensity (quality of attracting and holding attention) in advertisements by varying the white space surrounding a given field of printed or pictorial material. The experiment and its results are outlined as follows: "Four exposure cards the size of a standard double-page magazine spread were prepared with 0, 25, 50, and 75 per cent white space surrounding each of four pictures mounted on the left half of the spread. A picture the size of a page was mounted on the right-hand page and served as a competitor in the experiment. One hundred and twenty college students observed the four cards for a period of 10 seconds, but no Subject was informed of a time limit. No Subject saw more than one card. The ocular patterns were recorded by an eye-movement camera developed by the author."

"The results of the analysis reveal that each succeeding reduction in pictorial area or increase in white space is accompanied by a consistent decrease in attention time. Attention time resulting when observing cards with 25 per cent or more white space does not equal the attention time
when all space is filled. The losses of attention time for white space of 25, 50, and 75 per cent of the total field are 7.54, 21.01, 26.41 (seconds) respectively. This ratio of attention time to white space is significantly greater than the square root ratio obtained when size is the only variable. Advertisers purchasing space will gain most attention time per unit of space by reducing white space to less than 25 per cent of the field under consideration."

In a later experiment, Brandt (21, p. 230-239), while recognizing the difficulty of treating the problem scientifically, attempted to measure the degree of attensivity when the proportion of white space is varied. He used a portable bidimensional intermittent monofilm eye-movement camera to photograph the eye movements of the Subjects observing the exposure cards. Summarizing the experiment, he wrote, in partial contradiction of the above:

"With the pages of our periodicals crowded with hundreds of items of editorial and advertising (material), copy layout men are in a quandary as to just what technique to employ to gain attention. Since the problem of attention seems to be one of resistance to distraction; and, since isolation (surrounding white space) tends to reduce this distraction, white space may serve the purpose for which it was intended."
"Isolation, or white space, with all the advantages claimed for it may have possibilities within limits above and below 25 per cent of the area under consideration..... The findings of this study reveal that 25 per cent white space increases the attention-time above that of no isolation, and that isolation exceeding 50 per cent of the total area demands less attention-time than when the space is filled." While Brandt contradicted himself about the value of 25 per cent white space and found a larger percentage to be less valuable than the 25 per cent white space, he should have considered that his subjects had nothing else to do during their period of observation except to look at the magazine.

It would seem to the writer of this thesis that this fact should be considered in such studies and that the conclusions of Wilcocks (204) concerning "overlooking" and "resisting" stimuli should be considered in connection with the study of the values of various types of advertisements. To a very limited extent, Brandt (21, p. 230-239) did this when he wrote: "Starch believes that other things being equal, the amount and deviation of attention depend upon the absence of counter-attractions. According to his theory, isolation has both a positive and a negative application. The positive phase is satisfied by making one set of features in an advertisement prominent, and the negative
phase is fulfilled by avoiding competition among the various devices designed to attract attention."

In view of the foregoing, it might be interesting to compare the conclusions of Brandt with those of Strong (184, p. 104-116), who made some of the earliest studies on advertisements, and of Franken (67) who wrote in the same period. Strong believed that the effectiveness of a small advertisement can be profitably increased by buying more space and using the additional area as white space around the advertisement. He modified this statement, however, by expressing his belief that this would be true as long as the additional space did not exceed 60 per cent of the area of the advertisement proper. According to his calculations, about 20 per cent additional area used as white space around the advertisement would give a maximum effectiveness, cost considered. Franken (67) believed that about 25 per cent white space added to the attentional value of newspaper advertising. He suggested that white space is more effective in attracting attention than the boxes frequently employed to set off advertisements, and serves better than ruling for separating columns of print or of advertising.

Brandt (22, p. 564-574) also made a study by means of ocular photography to evaluate the relative attention value of size (of the advertisement), from which he drew the
conclusion that "large areas have attentional advantages over smaller ones, but that such advantage lags as the size of the area is increased." The findings of his study also indicated that "position and the character of the area are independent variables and potent determinants of attracting and sustaining attention."

Asher and Kahm (8, p. 431-436) suggested the possibility that "directions to the Subjects might create a 'set' favorable to one or another portion of the advertisement, and unfavorable to other portions. For example, the directions 'look at the advertisements in this magazine' might create a set which favors attention to illustrations, whereas, 'read the advertisements in this magazine' might result in a greater amount of attention to the reading matter in the advertisement." For this reason, they made a study "aimed to determine the effect of 'look' and 'read' directions upon the relative attention value of illustrations and texts in full page magazine advertisements."

The attention value was measured in terms of (a) the average amount of time spent in looking at the illustrations or the text in each advertisement, and (b) in terms of the number of first fixations on the illustrations and text in each advertisement. It was found that "in general, Subjects spend as much time and make as many first fixations on illustrations under 'read' directions as they do
under 'look' directions"; and also, "in general, Subjects spend as much time and make as many first fixations on the texts of advertisements under the 'look' directions as under 'read' directions."

"The rank-order of the attention values of the illustrations of texts of the advertisements remains essentially the same under the two sets of directions"; and it was concluded "that 'read' and 'look' directions have no appreciable differential effect upon the attention value of illustrations or texts in full page magazine advertisements."

Feller (63, p. 21-23) criticised the advertising cut of a messenger boy running from left to right and carrying a large placard with a message, in that he (Feller) contended that the direction of running would interfere with the reader's eyes in moving back to the beginning of the second line. The correctness of Feller's conclusion is open to serious question.

**Automobile Driving**

In the matter of the value of attention in automobile driving, Lossagki (115) reported that in the year 1933-1934, there were 250,000 traffic accidents in Germany, including 9,000 fatal ones. In 10 per cent of the cases, the ability of the driver to react properly was lacking; in 40 per cent,
there was lack of attention; and in 20 per cent, conditions for observation were inadequate. The author proposed to reduce the strain of constant attention on the part of drivers by certain modifications in the structure of the automobile, the highway, and traffic signals.

Mizzi (136, p. 262-277), in 1935, in a study of the "relation between diffuse attention, speed of perception, and estimates of speed and distance," reported that "an examination of the test results of 3500 applicants for positions as bus drivers and streetcar motormen in Milan showed no relationship between diffusion of attention, or speed of perception, and the ability to judge speed or distance. Satisfactory results on one of these tests coincided more often with unsatisfactory results than with similar scores on the others, so that any relationship was negative. It is suggested that other factors, notably a sense of time and space, might be more closely related to the ability to judge distance and speed, and that greater care must be exercised in interpreting test results until a proper test for these factors has been developed."

Lahy (111, p. 129-171), in 1938, made a "test of diffused attention, with mechanical record of learning and reaction time for chauffeurs," which purported to be a revision of a test used for ten years in selecting drivers. The Subject reacts with both feet and a push button to
sequences of lamps and bells. Improvements in this measuring device included making, with pens controlled by a vibrator, an automatic record of attempts necessary to reach a designated number of correct responses and the possibility of reading reaction time directly from portions of the record. There is a correlation of \(0.52 \pm 0.05\) between these records and the actual number of accidents occurring.

Matt (125, p. 104-112) studied the effects of the load of attention, or the complexity of situations requiring attention to already established reaction time, in connection with driving an automobile. A specially designed nonmobile automobile was used. Distractions were (a) meaningful to the situation and (b) not meaningful to the situation. A sounding automobile horn increased the reaction time 38 per cent when the Subject did not have to locate it, 81 per cent when he did. When the situation was made quite complicated, the reaction time increased 321 per cent; but when the situation was made simple except for someone talking to the Subject, the increase in reaction time was only 28 per cent. Matt concluded that (a) the length of the reaction time is proportional to the complexity of the situation and (b) ordinary or everyday disturbances have relatively little effect.
In a study made by Delucchi and Mata (48, p. 190-195), a simple method used in aptitude testing of aviation pilots by the Institute of Military Psychology in Buenos Aires was described. The concentration of attention and its distribution among various simultaneous stimuli were measured, the candidate being required to mark off various distances on a row of dots; in the middle of the activity, a metronome begins to sound at irregular intervals and the candidate must count the intervals in addition to the first task. Time and errors were scored, but few evidences of any validity of the method were offered, at least not in the abstract of the material which was available to this writer.

Forlano (66, p. 18-26) studied the effects of changing rather extreme temperatures on airplane pilots. His conclusion was that, if it should be necessary or desirable to expose the pilot of high speed craft to extreme temperatures, he will be able to perform with practically normal speed provided.....that the pilot be forewarned and prepared for each response and that the manipulation be restricted to simple all-or-none controls such as readily accessible keys and switches.
Summary

Too often the theoretical and experimental aspects of a topic are completely divorced from the applied aspects. This is true, to a regrettable extent, of attention. A summary of the applied section of this thesis shows the following conclusions: Directed attention is twice as efficient as undirected attention in a simple learning situation. Supplementary aids or cues assist in learning under conditions of directed attention. They do not enter undirected learning, even though present, unless they are discovered by the learner himself. The attention required in the performance of automatic acts is different from that necessary in doing selective acts.

Adults with average intelligence show considerable correlation between cancellation tests and typing, copying, and adding, as vocations; but the correlation becomes negative with adults above average in intelligence, probably due to a dislike of monotonous work. Pupils in vocational classes should be taught to work under conditions of distraction similar to those which they will encounter in their future employment. The hygiene and the fatigue of attention should be studied as problems of industrial importance. The control of attention as desired in industry is lacking in adolescents, but is found in adult
skilled workers. Different vocations may require different kinds or directions of attention, and, for that reason, tests should be developed for each of these.

Good ability in speaking may be developed faster from cultivating the habit of good listening and attention to the faults of others or of one's self in speaking. The average American adult spends approximately forty-five per cent of his active hours in listening. He should, therefore, learn to listen attentively and discriminatively.

Activity in attention should be promoted in preschool children in order to give them an advantage after they enter school. Quickness of accommodation of attention to new tasks or new ideas is an important industrial problem also. An attention quotient has been proposed, and used with benefit, with individuals and with groups. It is the ratio of the total number of minutes involved to the number of minutes during which attention is at least apparently being paid to the task at hand.

Concentration is not a gift, but a mental skill which must be developed.
THE NEURAL IMPLICATIONS OF ATTENTION
(EXCLUSIVE OF SENSE ORGANS)

Johnson (102, p. 610) made a brief but sufficiently comprehensive summary of the neural implications of attention as:

"(a) adjustment of the accessory sensory apparatus to facilitate optimal excitation of specific groups of receptors by a specific complex of stimuli (by action of the central nervous system). This is accompanied by

"(b) the adjustment of some specific effector-apparatus for appropriate response to these stimuli; together with

"(c) the inhibition (by the sensory nervous system) of activities which might interfere with such reception and response; and

"(d) the innervation of a very diffuse system of musculature which plays no direct role in the adjustment, except perhaps by serving to drain neural current from inappropriate pathways and to facilitate......maintenance of adjustmental attitude."

Johnson (102, p. 602), among others, discussed the theoretical division of attention into central and
peripheral, that is, within the central nervous system, or within the peripheral nervous system. He favored the peripheral, although this seems—to this writer—to be a rather senseless limitation of the term "attention." It seems quite obvious to this writer that there could be no peripheral attention except through the directing influence of the central nervous system.

In this connection, James (101, p. 428) wrote: "When an impression is fully anticipated, attention prepares the motor centres so completely for both stimulus and reaction that the only time which is lost is that of the physiological conduction downward, but even this interval may disappear; i. e., the stimulus and the reaction may become objectively simultaneous or--more remarkable still--the reaction may be discharged before the stimulus has actually occurred."

Marzi (122, p. 177-180) (123, P. 203) studied the selection of the contents of consciousness; that is, the things which were to be or were being attended to. By means of short and of longer tachistoscopic exposures, he found that in the former the emphasis of the attention is on the mechanistic "grasping" of the material presented, while in the latter there is a voluntary selection of material which occurs according to analyzable motives, and which varies with the individuals experimented upon. He
termed attention to the shorter exposure "spontaneous attention," but it is doubtful that this serves any useful purpose and it does imply that is is related to or is "involuntary attention" which is undoubtedly incorrect.

In addition, Marzi (123, p. 203) studied the difference between the results obtained by showing some pictures containing heterogeneous objects and others with unity of meaning in order to work out laws of selection by means of attention, but he offered no conclusions.

Where Cassell and Dallenbach (37, p. 129-143) wrote that there is "no reason why a description of attentive behavior need be accompanied by discussion of clearness of content," Horst (97, p. 421-432) made clearness the center of the attentive process. "Whether an event will be in the center of our attention depends on its inherent vividness, the extent to which it is repressed by other events, and our volition as expressed in active concentration. Attention intensifies the psychic event, increases the psychic tempo, prolongs the duration of the psychic reaction, rearranges the total aspect of consciousness, interferes with (undesired) peripheral perception, and eliminates (unwanted) emotions. Attention is attracted by great intensity, strong affective moments, and novel contents; but sustained attention requires medium intensity, internal unity of content, and personally significant content." He
also discussed the measurement of attention and its fluctuations.

Galdo and Popa (72) and Galdo (74, p. 255-273) studied the flow of blood through the cerebrum during strong visual attention and during muscular work. They found a marked increase in cerebral circulation during attention but no characteristic or constant modification during muscular work, and believed that the former was due to the greater work of the brain during attention. It remains to be demonstrated, however, that the cerebral circulation is parallel to the amount of work which the brain is doing.

During the last two decades, the use of encephelographs has opened new possibilities for the study of cerebral activities as they are occurring. Burrow and Galt (30, p. 287) wrote in their summary: "There has been the attempt to correlate various phases of attention with brain-wave patterns through spectral analysis of the EEG (encephalograms) drawn off from the various brain regions. In particular we have been occupied with the differences in brain-wave pattern where (a) an individual's attention is pre-occupied with affective, socially disjunctive elements (ditention) and (b) where attention is free from these impediments, and functions in alignment with the organism's basic motivation as a whole (cotention). Our data show that in cotention, as compared with ditention,
there is a marked drop in the energy-output....and that this drop is registered predominantly in the motor ranges. Intense attention (mental work), on the other hand, did not bring about a consistent change in energy-output. A further series in which the Subject read in the two attentive phases substantiated the difference in the two brain-wave patterns."

Burrow (32, p. 109-114) (33, p. 505-506) had earlier established a relationship between the encephalographic records of neurotics and of normal people and between those of normal people under conditions of cotention and dition, or of attention to things with a minimum of affective content and with a larger affective content. He considered this relationship of extensive importance to the psychiatrist.

Burrow (31, p. 174-186) also studied the effects of attention and cotention on the respiratory rate, the minute volume of air inspired, the tidal air, and the oxygen utilization by means of kymographic tracings. Under conditions of attention, three modifications were noted: slower respiration, diminution of eye-movements, and the absence of affecto-symbolic images.

Harrison (87, p. 20-29) studied the electroencephalograms taken from a single individual at various times rather than those from numerous individuals a few times.
Extensive fluctuations were found in both. It has been found that "as far as the occipital alpha rhythm is concerned, the general consensus of opinion seems to be that it is most readily suppressed by stimuli producing either a state of focused attention or of autonomic tension in the Subject." Harrison (87) proposed to test the effects of various stimuli-situations upon the alpha rhythm of a single Subject tested a large number of times. His conclusions were: "There is a low positive correlation between the degree of suppression associated with mental arithmetic and concentration problems. This appears to indicate the existence of common mental (or neural) activities for these two tasks. The lack of correlation between these two tasks and the immediate memory span test suggests that the attention associated with immediate memory processes is to be distinguished from that involved in arithmetical problems and indicates specific types of attention. Suppression of the alpha rhythm is associated with the focusing of attention, but is an unreliable guide to the degree of focusing. This indicates a lack of direct connection between attention and the amplitude of the alpha rhythm. The neural processes directly responsible for the suppression of the alpha rhythm take place below the level of consciousness since the Subject is unable to state the degree of suppression associated with a particular stimulus."
Fearing (62, p. 1-24) studied the effects of controlled and of uncontrolled attention on body sway or static equilibrium. Attention was (a) undirected, (b) directed to parts of the body, (c) directed to reduction of body sway, (d) without distraction and (e) with distraction in the form of a small gong struck at the rate of 120 times a minute. He concluded that this distraction reduced the body sway in sixty Subjects to a larger extent than direct attempts to reduce it through attention.

Skaggs et al (174, p. 749-755) in repeating Fearing's study found that their results in part confirmed and in part negated those of Fearing in that some Subjects swayed less and some more when their attentions were directed to the reduction of body sway, and that the same was true when their attentions were directed to extraneous matters. Skaggs used direct attention to body sway, to mental multiplication, and to reading. The data showed that both groups of men and of women, with individual exceptions, swayed least while doing mental multiplication. They swayed more while reading than while directing attention to the reduction of sway. It was concluded that the reduction of sway during attention to that situation was a deep-seated individual difference which resisted the effects of practice. In two further experiments with a small number of subjects, it was found that some swayed more and some
less under two conditions of muscle tension.

Galdo (73, p. 249-264) (74, p. 255-273) used an ergograph to study the relation between muscular capacity and various conditions of attention. He offered no conclusions except his belief in the possibilities of the method.

The work of contracting a finger to which a small weight was attached by means of an ergograph was studied by Burghmann (29, p. 273-276) under conditions of no distraction and of tracing a star pattern and of adding numbers mentally. He concluded that mental and muscular activity cannot be isolated, but that muscular fatigue effects are greater under manual distraction than without distraction and are less than normal under conditions of mental distraction.

Investigating the problem of concentrated attention and vegetative reactivity, Miliavskaya (134) gave Kraepelin's test to ninety-nine children, fourteen and fifteen years of age, taking records at the same time of respiration and of psychogalvanic reflex. An automobile horn was used as a distractor. The results showed that the introduction of a distractor affected these vegetative reactions. In children with strong psychogalvanic reflexes, the distraction was about 20 per cent greater than among children with weak psychogalvanic reflexes. The pneumographic results were similar but less clear.
Bitterman and Soloway (18, p. 134-136) had ten Subjects work for four fifteen-minute periods on the Minnesota Test for Clerical Workers. During two of these periods, a record of a man's voice reciting numbers was played continuously at a sixty decibel level. No decrease in either rate or accuracy was shown during the periods of distraction. He did not, however, eliminate practice effects from the study. He did find that the heart rate was greater during the distraction periods than during the work periods without distraction, and was, in turn greater during these periods than during periods of no work. He found, in addition, that there was no increase in frequency of eye-blink under either condition of work and that eye-blink bears no relation to the difficulty of the task.

**Summary**

Attention requires, or brings about, the adjustment of accessory sensory apparatus in order to facilitate the reception of expected sensory stimuli and to exclude undesired sensory stimuli. It also causes the adjustment of specific effector apparatus for appropriate response. It causes, in addition, the innervation of a very diffuse system of musculature which plays no direct role except perhaps by serving to drain off neural energy from inappropriate pathways. Concentration and distraction affect
even the vegetative nervous system and the vegetative reflexes, possibly showing the original relation of attention and self-preservation.

The intensity of attention affects the rate and depth of breathing, eye-movements, the types of mental energy, and the EEG wave patterns. These latter, are as yet, unreliable guides to the degree of concentration.

The flow of blood through the cerebrum is larger during attention than during muscular work, but the meaning and the importance of this remain to be discovered. Attention to mental multiplication seems to decrease body-sway more than direct attention to the decrease of body-sway, but reports on this are controversial.

Encephelographic recordings of people occupied with socially disjunctive mental content and those with mental content free from worrisome material show different amounts of mental energy output and different wave patterns. EEG recordings for people not under emotional strain, for people under emotional strain, and for neurotics, should be of importance to psychiatrists.
SENSE ORGANS - THEIR EFFECT UPON ATTENTION

Visual

It is obvious that the quality of the sense organs affects the direction, the duration, and the effectiveness of attention. If one's hearing, for example, is poor, he will probably avoid those stimuli or those activities which require its use. He will probably use his hearing, when he has to use it, for the shortest reasonable time; and he will not, probably, get as much from his auditory efforts as other people with better hearing do. It is possible, however, that he will compensate for his weakness--or try to--by unusual effort and by the development of his use of small signs and cues which people with better hearing neglect because they do not need them; and, in this manner, he may hear more accurately and more fully than people with better auditory equipment do, since they neglect these stimuli because they do not need them, or believe that they do not. He hears more, as a result, because he gives more attention to his acts of hearing.

In a series of studies of the transition from immediate to more prolonged attention as it is affected by "total" and "discrete" attention, Meyer (131, p. 321-516) used nine Subjects in various experiments. One of his conclusions was that imagery types, e. g., audiles and visiles, are
independent of attention types (discrete as opposed to total). The total type is easily recognized by its quick reproduction of memory material; the discrete type by slow reproduction. The span or quantity of reproduced material is greater in the case of total attention, but the qualitative errors are also greater. These distinctions, however, hold only during the initial presentation of a nonsense syllable series. The characteristic features of total and discrete attention are modes of adjustment appearing in immediate memory, disappearing in delayed recall. These types are not to be identified with the concentrative and distributive types of attention.

That attention affects the material received by the brain from the sense organs was shown by Guratzsch (81, p. 257-310) in his study of peripheral vision. He used four young men and a visual projection perimeter in which each Subject fixated a center point with both eyes. The clearness of points of light at various degrees on the circumference of the perimeter was determined by finding the limen of detection of the presence of these lights. The Subjects were directed to (a) distribute their attentions over the whole field of vision, (b) to concentrate attention on the center of the field, or (c) to concentrate it on a side point. The visual clearness was best when the attention was distributed over the whole visual field.
When attention was concentrated on a single point, the loss of cleanness in the rest of the field was greater than the gain in cleanness for the region observed, and the loss of cleanness varied directly with the distance from the point observed.

Bretschneider (24) used a similar technique except that he used black circles instead of lights in the study of peripheral vision under conditions of variously directed attention. He found that "sharpness" or clarity of outline declined steadily with increased distance from the point of concentration of attention, but was greatest when attention was distributed over the whole visual field.

Guilford (79, p. 534-583) studied the fluctuations of attention with weak visual stimuli. He concluded that such fluctuations are governed by the same rules as other liminal fluctuations. The length of the periods of visibility and invisibility of liminal visual stimuli are functions of the intensity of the stimuli. Such physiological conditions as retinal adaptation, eye-movements, and local or central fatigue or inhibition affect these fluctuations. Guilford's fourth conclusion is much more remarkable and much less defensible; namely, that neither from psycho-physical evidence nor on the basis of phenomenology can these fluctuations be called fluctuations of attention. Other experimenters, at least, have believed that attention
does affect the limen of visibility.

Semenovskaia (167, p. 148-168) found that voluntary attention in examining scarcely distinguishable objects under conditions of dark adaptation increases sensitivity to light, depth, and visual contrast. Distractions of attention by weak knocking lowers peripheral sensitivity to light and decreases sharpness of depth perception, but increases sensitivity to light in the central area under conditions of sustained attention.

According to this author (167), attention in the visual sphere increases sensitivity in the auditory sphere, and vice versa. Visual attention influences the breathing and the electrical resistance of the skin, thus demonstrating that the vegetative nervous system is involved. Over-attending, (worry), however, may lead to reduction of visual sensitivity.

Haber (83, p. 316-328) (84, p. 229-245) called attention again to the longer reaction times required when either the background, the stimuli, or the reaction is complex rather than simple; in other words, the more activity required from attention, the longer the time required. He used visual stimuli under numerous and varying conditions.

Studying the distance of a visual stimulus from the point of fixation as an influence upon the attention which it received, Friedline and Dallenbach (71, p. 464-468)
found (a) that the greater this distance is, the less the attention-value of the stimulus and (b) that position of the stimulus with respect to the point of fixation is a determinant of attention.

Meisenheimer (130, p. 1-130) used a different apparatus from Friedline and Dallenbach, but studied the same psychological phenomena and arrived at the same conclusions.

Many years ago, James (101, p. 436) noted most of the above material. "We may attend to an object on the periphery of the visual field and yet not accommodate the eye for it. Teachers thus notice acts of children in the school room at whom they appear not to be looking. Women in general train their peripheral vision more than men. Practice enables us, with effort, to attend to a marginal object whilst keeping the eyes immovable. The object never becomes perfectly distinct.....but we become more vividly conscious of it than we were before the effort was made."

James also noted (101, p. 409), "When expectant attention is concentrated upon one of two sensations, the other one is apt to be displaced from consciousness for a moment and appear subsequently although in reality the two may have been contemporaneous events...... Thus, there is a certain difficulty in perceiving the exact date of two impressions when they do not interest our attention equally, and when they are of a disparate sort."
Anderson and Crosland, (2), (3), (4), and (5, p. 701-713), studied the influence of eyedness and handedness upon the "range of attention" as shown by its influence upon the apprehension of letters in various positions to the left or the right of the point of visual fixation. They found that the left-eyed or the left-handed Subjects were convincingly and consistently superior, in the size of the visual field which they could survey, to the right-eyed or the right-handed Subjects.

Travis and Hall (193, p. 472-479) studied the effects of attention to visual after-images upon the electroencephalographic waves under conditions of high and of low attention. For the high degree of attention, the total duration of alpha waves and the mean duration of the bursts during the after-sensation periods were less, and the length of time for the burst to appear after the light went off, was greater than for the low degree of attention. These findings indicated a greater effectiveness in altering brain potential patterning by conditions of greater attention. It was calculated that the attentional factor contributed as much as thirty-five per cent of the total effect, the functional properties of the retina probably contributing a large part of the remainder. It was believed by these writers that variations in attention may be revealed in brain potential patterning and thus be
objectively determined.

Tournay (191, p. 257-280) made observations on patients who, without showing any lack of capacity for attention in general or giving any evidence of fundamental sensory or motor defect, were incapable of fixating steadily certain visual stimuli. He ascribed this to a defect in the occipital lobe (visual area) of the brain. Although this disorder is basically physiological, it has psychic repercussions inasmuch as it affects spatial orientation.

Auditory

In a study of fluctuations of attention with weak auditory stimuli, Freiburg (69, p. 173-197) first established limens for various pure and combined tones. This is a somewhat comparable study to that of Travis and Hall (193) in the field of vision. Freiburg reached numerous interesting conclusions, one of which was that fluctuations of attention are due to a complex relationship between the adequacy of the effect of the presented tone and the other excitatory factors of the peripheral and the central apparatus for hearing--some of which are observed as tinnitus. The operation of these factors is seemingly in accord with those of visual fluctuations. There is a definite relationship between intensity of tone and rate of
fluctuation. The most rapid fluctuations occur at intensities that are heard approximately half of the time, and there is a decrease in the rate of fluctuations as 0 per cent or 100 per cent audibility is approached.

Where Freiburg (69) wrote: "Under the conditions of our experiment, auditory adaptation does not occur, it having been pretty well eliminated in the establishment of the limens," Hennebert (92, p. 17-21) wrote: "It has been experimentally demonstrated that the auditory threshold can be successively lowered by reducing the intensity of the sound by successive steps of five decibels beneath the just previous threshold. This lowering of the threshold is due, not only to the central influence of attention, but also to the peripheral contraction of the ossicles of the middle ear as an adaptive process."

Travis (192, p. 139-142) found that auditory acuity was increased (or the limen lowered) when one was completely absorbed in an impersonal or unemotional mental task, whereas a higher limen during this kind of task was held to indicate a lack of ability to become completely lost in the operation.

Tactual

Freiburg (70, p. 23-36) studied the fluctuations of attention in relation to liminal tactual stimuli. Two of
his conclusions were: "The most striking phenomenon following the stimulation of cutaneous or sub-cutaneous pressure end-organs with point or areal stimuli of approximately liminal value is the rapid disappearance of the experience thus aroused. The few 'fluctuations' which do occur result from inadequate controls in experimenting"; and "The disappearance of the tactual experience is due to the rapid adaptation of the receptors involved--and no amount of attention will bring back the experience."

Faul (61) made an unusual but practical study of the influence of climatic factors upon the ability of school children to concentrate their attentions upon their tasks as shown by their records in the cancellation of letters and digits. He found improvements in these records when the temperature dropped from twenty-nine to sixteen degrees Centigrade, when the wind velocity decreased from seventeen miles an hour to zero, and when humidity varied between forty and sixty-nine per cent rather than being above seventy. Combinations of these factors influenced performance more than any one of them alone; high temperature and high humidity being unusually harmful in their effects upon attention as shown by records in cancellation.

Bagchi and Gruwold (9, p. 235-248) studied the effects of small temperature changes in the palm of the right hand under various conditions of musculature tension, e. g.,
general tension, mild tension in the right arm, strained tension in the right, and so on. Since the degree of tension was held to be a rough index of attention, it was found that varying degrees of attention affected the Subjects' abilities to observe small changes in temperature.

Heinrich and Strzemposz (90, p. 321-349) conducted an experiment on cutaneous temperature in an almost directly opposite manner. They pushed a thermoelectric needle gently into the skins of two Subjects in turn, and found that the body temperature—at least in the area around the needle—rises when the Subject's attention is directed to this area.

**Summary**

**Visual**

People of various imagery types respond in their accustomed manners whether they are directed to use "total" or "discrete" visual activity, i.e., looking at the whole of the visual field or at the parts making up the whole. (This is not the same as concentrative and distributive attention).

The quality of the visual performance in the detection of a liminal stimulus varies when the attention is directed to the whole field or to a point in that field. While there is gain when the stimulus is near the point of
fixation, there is a greater overall loss when the stimulus is moved over the whole field.

Distractions and worry lower the quality of the visual detection of liminal stimuli. Concentrated attention in the visual area increases auditory sensitivity, and influences breathing and electrical resistance in the skin.

Ease or difficulty of seeing an object affects the attention given to it.

**Auditory**

In the study of sensory thresholds, auditory fluctuations follow the same rules as visual fluctuations. Both are influenced by the quality of the attention given. There is direct and complete contradiction between experimenters on the possibility of lowering the auditory threshold by attentive practice.

**Tactual**

No amount of attention, apparently, will overcome the rapid adaptation of the tactual sense organs to liminal stimulation and the disappearance of the reaction.

Uncomfortably high temperatures, wind velocity, and humidity decrease work output. A combination of all of these has more effect than any one alone. Distractions in other sensory areas raise the tactual threshold.
ATTENTION UNDER ABNORMAL CONDITIONS

Any psychological factor is subject to extremes which may go so far as to be called abnormal. This is true of attention, in that abnormal people have abnormal attentions, or attention can be so small or so large or so misdirected as to be abnormal. This section deals with attention as it is found under conditions of: fatigue, emotion, psycho-neurosis, alcoholic imbibing, use of benzedrine, extroversion, constitutional types, left-handedness, stuttering, hypnosis, and feeblemindedness. The number of papers is so small, however, that few, if any, conclusions can be drawn from them.

Fatigue

While fatigue is normal, a person who is working under conditions of marked fatigue cannot be considered fully normal at the time. Verwoerd (197, p. 595-601), using the modified Attention-and-Fatigue Meter of Piorkowski, had his Subjects react for long periods without resting. He presented the following conclusions: Sometimes the general score of accomplishment suffered. This might or might not be accompanied by an increase in the unevenness of the distribution of attention between stimuli to the left and to the right of the Subject's visual area. There was,
sometimes, a marked increase in the unevenness of the distribution under conditions of fatigue without a loss in the general score of accomplishment. There were, also, instances of a narrowing of the field over which the attention was distributed without the general height of performance decreasing. It sometimes happened that stimuli from either one or both of the outer portions of the visual field, or from the central portions, were noticed less than at first (in an unfatigued state). The general score decreased if the stimuli in the remaining portions were noticed only to the extent that they had been at first, but in some instances of a narrowed field, more reactions and more accurate reactions were made than when the Subjects were unfatigued. In some of these instances, the total scores remained the same or even increased. In some cases, no fatigue effects at all were to be observed from even long periods of work with this device. For this reason, Verwoerd stated that this device, even when modified, is not suited for testing fatigability where sustained distribution of attention is necessary.

Schuschakoev and Anasjew (166, p. 64-65) tested four railway station employees before and after work for several days and nights, using simple arithmetic calculations, cancellation, and number checking. A decrease in attention according to the scores on these measures occurred in the
before-and-after-work comparisons, the average decrease being 20 per cent.

From these two studies, one may conclude that fatigue has a limiting influence on attention and upon the effectiveness of attention.

**Emotion**

One might expect that emotion would have a harmful effect upon attention by reason of distraction or dispersal, but one might also expect a greater amount of attention in an emotional situation if one believed that sufficient and skillful thought and action would prevent a disaster and cause a satisfactory solution to be achieved.

In a relatively simple laboratory situation, Skaggs (173, p. 313-319) first correlated pulse rates and breathing rates and depth with emotional and non-emotional states in a group of Subjects. He used mental solving of problems under conditions of what he called "emotional and non-emotional attention," and devoted some paragraphs to a defense of these definitions. For the arousal of emotional attention, he used: expectations of electric shock, actual shock, and loud noises during expectations of shock. His data indicated that: non-emotional work produced the most shallow breathing; mental relaxation produced the greatest amplitude of breathing; anticipation of shock led to a
greater amplitude of breathing than mental multiplication did; breathing was fastest during mental multiplication but was very shallow; and emotional conditions and electric shock led to deepest breathing.

Pulse rate (173, p. 313-319) was least for mental relaxation; it increased during mental work; it increased still more during expectancy of shock; and was greatest in the half-minute following the emotion producing noise. Under these conditions, the women were more emotional than the men.

Diethelm and Jones (49, p. 325-336) investigated the effect of anxiety upon performance in tests of attention, retention, and thinking, by means of several tests commonly used by psychiatrists. Between thirty-five and sixty-four patients were tested and retested before, during, and after, periods of anxiety. The results indicated that anxiety exerted a detrimental effect on each of these psychological factors, including attention, in most of the Subjects.

Mandeville (119, p. 121-164) (120, p. 54-55) wrote up his general observations on the relationship of timidity and attention. Timidity implies an alteration of attention because it presupposes poor adaptation to reality. The timid person, like the obsessed person, is inattentive to the things usually attended to because he fears appearing ridiculous.
Disorders of attention are of very frequent occurrence among psychoneurotics. In most cases, they take the form of absentmindedness, forgetfulness, incapacity for concentrating on one subject. In some patients, these are not very obvious and reduce the general efficiency of the patients little, if at all. There are, however, large numbers of patients affected by psychoneurosis in whom disturbed attention is one of the main pathological symptoms.

Butorin (34, p. 235-251) investigated his patients (a) through psychological analysis of their complaints, mostly of disturbed attention, absentmindedness, and forgetfulness; (b) by observation of the patients' behavior and activities; and (c) by experimental studies of the stability, fatigability, and intensity of their attention and its dependence on the morbidly disturbed attitude of a psychoneurotic toward his actual environment. He used Kraepelin's test in studying the stability of attention. This test involves the addition of two-place numbers with a registering of the point at which one is working every two minutes. Distractability and changes in attention were studied by means of individual observation during the taking of the Bourdon Test.
His conclusions (34, p. 247) were: Psychoneurosis is a morbid condition resulting from a disturbed interrelation between personality and reality. Such patients continue to experience mentally the situations which were the cause of their mental trauma and remain indifferent to much or to everything else. "Asthenic attention, which is characterized by rapid exhaustion, particularly under conditions of a voluntary fixation of attention, may remain fixed to an object for a considerable length of time without causing fatigue, providing the patient is interested in his work, for this saves him the effort of keeping his attention fixed." This is, in a way, a form of inattention. In the case of gliding attention, the functional instability of the attention is aggravated by the patient's instability of attitude (or emotional or anxious state). "Emotionally unstable attention is directly dependent on the emotional experiences of the patients which reduce the voluntary components of their activity and determine the fixation of the patient's attention in accordance with his inclinations."

"Distractable attention is connected with the increased reactivity of a psychoneurotic to outward stimulations, and often with the emotional experiences accompanying this condition which divert the patient's attention from his occupation. Interruptible attention is caused by deeper lesions in the dynamics of psychic processes which
result from intimate changes in the mechanism of attention. A factor which contributes to the onset of these interruptions is fatigue."

"It should be noted (34, p. 249) that disturbed attention is not merely a symptom, but, in a number of cases in which it impedes the working process, it is also the cause of the painful emotions experienced by a psychoneurotic and a foundation for the development of psychogenic symptoms."

Evergetova (58, p. 115-128) studied changes in "the psychic and motor attention" in psychoneurotic children by the methods of Kraepelin, Bourdon, and Piorkowski. The cycloid children showed good motor attention but a decrease in psychic attention. The schizoid neuropaths showed an inhibited tempo in motor processes and a low coefficient in the Bourdon Test. The constitutional neuropaths showed low psychic and motor attention. The neurasthenics showed a decrease in psychic attention only. The patients with organic diseases, such as post-encephalitis, showed quick exhaustion of attention.

The variations in twenty cases of dementia paralytica were examined by Day (46, p. 82-128), using principally the Bourdon Test. He found: accommodation of the attention to be prolonged; full attention to be manifested in only a third of the cases; motor reaction time to be as long as 142 seconds; and the relation between motor velocity and
the constancy of attention to be greatly reduced.

Falorni (60, p. 335-375) studied the vagaries of attention among approximately 100 retarded and abnormal children. He defined attention as the degree of tension in mental activity. He attempted correlations between the various types of attention and the clinical diagnoses of abnormality.

Forty cases in which failure in concentration was a major complaint as a result of war neurosis were studied by Tredgold (194, p. 177-182). All of these cases had histories of severe bombing and a degree of exhaustion. Three types of conditions among these forty cases were defined: (a) residual cases, in which failure of concentration was a principal symptom; (b) insidious cases, which showed a gradual increase of symptoms; and (c) depressive cases. In all cases, the failure of concentration was evinced as an early tiring of attention.

Twenty-three insane patients who were undergoing electric shock therapy and twelve patients not undergoing such treatment were studied by Delay and Binois (47, p. 182-187) who used cancellation tests as measures of attention. Each of the first group was tested before the first shock, two days after each subsequent shock, and eight to fifteen days after the end of the treatment. The attention-ability of the patients undergoing shock appeared to remain unimpaired
or even to improve during the course of the treatments. The attention of the twelve not undergoing shock appeared to improve almost on a parallel with that of the shock patients, however.

Storung (183, p. 257-384) reported the case of a person "with complete, isolated loss of attentive capacity" although attention here seems inextricably interwoven with memory. The patient, suffering from gas poisoning which had occurred in May, 1926, was described as having lost the ability to retain any experience since that time. He could carry on conversation, answer questions, carry out commands, etc., provided the sentences spoken to him were not too long. If the commands were repeated, they were perhaps carried out. Memory span seemed to be extremely short, ranging from one to two seconds. A striking illustration that was typical of the patient, was that, although he had been married for a year or more, he had no memory of that fact, and still looked upon his wife as his fiancee only; and each time he saw her, even though it might be a hundred times a day, it was as though for the first time after long separation. His memory for events before the poisoning was equal to that of a normal person for a week past. This led the author (183, p. 257-384) to make the statement that forgetting is not due to lapse of time per se, but rather to events happening during that time.
No disturbances in other functions were present which could not be traced to the patient's inability to retain recent experiences. Perception, recognition of situations, persons, and objects (save those experiences during the last five years), feeling, voluntary activity to a certain extent, judging ability (providing it did not require the retention of experiences of the last five years), seemed to be largely normal. It was this fact that caused the author to hold this to be the first pure case of its kind on record.

According to Soken (176, p. 116-137), the coefficients of variation of reaction time values indicate the capacity for concentration. The best concentration is found in Subjects with average reaction time, but the correlation is only plus .35. This author pointed out the desirability of standardizing tests for use in psychiatric and neurological diagnosis on both normal and abnormal Subjects of various educational levels, and in sufficient numbers to permit the establishment of central tendencies and ranges of variation. He believed that, if this were done, acceptable quantitative norms could be established even for single attributes of the mind.

Continuous experiments in addition were carried on with so-called neurasthenic patients (nervous persons, neurotics, and patients with syphilitic neurasthenia) by
Hiratsuka (95, p. 270-291). This work resulted in unrest, instability, feelings of unpleasantness, and fatigue. Such patients are unusually distractible in the presence of disturbing noises, show weak adaptation to external stimulation and introspectively peculiar mental content. Some can suppress their distractibility by strong resistance, however.

Davis (45, p. 22-29) wrote that it is often difficult to get the insane patient's attention to therapeutic activities. Rather primitive activities, such as group contests, and tugs-of-war, have proved rather effective in evoking the desired attention.

The reactions of patients who had post-encephalitic Parkinsonism were studied by means of the psychogalvanic response, the Rorschach Test, and tests of intelligence, attention, and suggestibility, by Tumin (195). The attention of these patients was found to be subnormal.

Horey (96, p. 319-329) subjected certain theories about extroversion and introversion to experimentation in comparison with scores on intelligence tests and by having both extroverts and introverts work on mental tests under conditions of general distraction. He found that extroversion and introversion on the one hand are not related to distractibility on the other.
Mayerhofer (126, p. 257-267) studied the effects of one or more ingestions of forty cubic centimeters of alcohol under controlled conditions in order to study the effects upon the "drivers" of a Moede test automobile, and on the Bourdon Test of Attention. Three of the Subjects were non-drinkers, and three were moderate drinkers. Among these Subjects, the non-drinkers were more affected on both measuring devices than the drinkers were, but the effects of the alcohol were variable. The effects of alcohol on attention brought about changes which may be compared with those found in highly neurotic persons. "According to these results, it would be unjust to generalize about the effect of alcohol, especially in connection with automobile accidents.

In Lahi's experiment (110, p. 207-211), seven hungry Subjects were given absolute alcohol in water calculated to produce concentrations in the blood of either 0.1 per cent or 0.5 per cent. Three series of tests were given at thirty-minute intervals after the alcohol began to be in the circulatory system. These tests showed that responses in the test of attention were slower and less accurate than when Subjects were normal in regard to alcoholic content, that mental work was less well organized, and that errors
increased in the test requiring concentration upon manual responses.

**Benzedrine**

Barmack and Seitz (10, p. 241-247) studied the size of the area subject to visual attention in eighteen male Subjects under three conditions: (a) in normal atmospheric pressure and after taking a neutral pill; (b) a simulated altitude of 16,000 feet—with subsequent oxygen deprivation—and a neutral pill; and (c) a simulated altitude of 16,000 feet plus ten milligrams of benzedrine sulfate. Each session lasted approximately an hour. Fifteen Subjects filled out a subjective rating sheet each, after each session. Under the conditions of the experiment, no difference was found to be produced by the three experimental situations in the "span of attention for letters," that is, the width of the visual area. The subjective data suggest that exposure to a simulated altitude of 16,000 feet for the period of an hour causes a depression in mood, which may be counteracted to some extent by ten milligrams of benzedrine sulfate.

These same authors (10-a, p. 195-196) experimented on the effects of ten milligrams of benzedrine sulfate on the average "attention spans" for letters of thirty-two college students used as Subjects. They found that the benzedrine
had no effect on the "span of attention" for letters. Since they did find a substantial practice effect between the first and second sessions of the experiment, their results can be assumed to be valueless inasmuch as the practice effects should have been eliminated in the establishment of norms of accomplishment before the benzedrine was administered to the one group and a neutral pill to the other group.

Stuttering

In their study of "The Factor of Attention in Relation to the Moment of Stuttering," Knott and Johnson (106, p. 479-480) wrote: "Given a communicative situation, and given a strong desire or drive on the part of the stutterer to speak without stuttering, i. e., to inhibit stuttering, then the stutterer will have a strong tendency to attend to the following: (a) potential stuttering (to be avoided) and (b) actually experienced stuttering (to be avoided or minimized). Whenever, in attending to potential stuttering, toward which the stutterer expresses avoidance reactions, the total speech behavior tends to be inhibited, this attentional set heightens the stutterer's sensitivity to such an extent as may lead him to believe that the moment of stuttering is at hand, and in so doing, it is instrumental in calling out the actual inhibition of
of speech (stuttering). This is possibly analogous to the attentional set utilized in reaction-time experiments involving the so-called muscular response, in which the attention is directed to the preparation to respond in a definite manner, any cue or signal being sufficient to set off the subsequent expected behavior.

"The stronger (106, p. 480) the attentional set to stuttering, either potential or present, the more inhibited will be the speech behavior of the stutterer in the situation, this rule being valid in proportion to the degree that the attentional set provokes avoidance reactions on the part of the stutterer."

Feeblemindedness

The attention spans of the feebleminded are so obviously small and the durations of their periods of attention so obviously short that few records of this factor have been made. The poverty of attention of the feebleminded is roughly parallel to the degree of feeblemindedness; that is, idiots have poorer powers of attention than imbeciles and imbeciles poorer powers of attention than morons. There are variations among the feebleminded in their attentions, however, some paying lethargic and slow-moving attention to one object or idea for a long time, and others, who appear "bright" upon first observation, flitting from object to
idea and back to object in a bird-like manner, pausing for a second or two only on any one.

Robin (156) made a neurological interpretation of a form of idiopathic inattention in children from which he observed that there are inattentive children whose difficulty does not reveal a psychomotor syndrome of instability or morbid constitution. These are children who are inattentive in spite of themselves, in spite of good will, evident mental effort, and good intelligence. They are not scatterbrained, distracted, or dreamers; but they remain unproductive. Aside from short periods, during which attention is forced or voluntary, their attention is idiopathic inattention. These children, according to Robin, are ill rather than mentally deficient.

Stoenescu (182, p. 62-63) used the Toulouse-Pieron Test of Attention with 148 insane and feebleminded patients. If the score for normal people is set at 134; the average score for idiots was 0; for imbeciles, 15; for insane "in mental confusion," 20; for epileptics, 34; for general paralytics, 72; for melancholiacs, 76; for schizophrenics, 77; for manics, in the mania stage, 78; for paraphrenics, 80; for psychoasthenics, 100; and for paranoiacs, 108.
Summary

In this section, various investigations with regard to attention, as it is affected under abnormal conditions, have been outlined and the data pertinent thereto have been reviewed, though little very conclusive evidence seemed to be available.

Among the conclusions found were the following:

fatigue limits the attention and cuts down its effectiveness; emotion may either have a detrimental effect upon attention, or it may serve to alert and increase the attention of the individual, depending upon the situation which may be the cause of the emotion; disturbed attention is one of the main pathological symptoms among psychoneurotics and those persons suffering from other abnormal mental states, and individuals of this type are easily distractible; the use of alcohol causes attention to be less alert, less accurate, and less well organized, although these effects vary in degree among individuals; the very struggle of the stutterer to focus attention in order to prevent his stuttering may be a means of defeating his purpose.

The attention spans of the feebleminded are so obviously small and their durations so short that little has been written about them. The quality of the attentions
of the feebleminded is roughly parallel to the degree of feeblemindedness. The attentions of the feebleminded may be lethargic, misdirected, or flitting. In some cases, otherwise intelligent children may have the attentional abilities of the feebleminded, but these children should be considered ill rather than unintelligent.
CHAPTER III
A SUMMARY OF THE CONCLUSIONS
FROM VARIOUS STUDIES OF ATTENTION

The summarizing of the vast amount of often contradictory, occasionally biased or "slanted," and usually very fragmentary material on attention is attempted in this chapter. The bibliography of this thesis, which means "literature cited," contains 209 titles out of the much larger number extant. Many of these have been read by this writer, but have not been included because they appeared to contain little or nothing of value, or were simply later repetitions of earlier papers with little or nothing added. Where translations of articles or of abstracts from the foreign language journals were available, these were read; when these were not available, the abstracts in the Psychological Abstracts were used. These have been marked "abstract" in the bibliography.

Of all the papers which have been written, none has yet quite arrived at the core of attention--just what it is--or the complete way in which it operates psychologically and physiologically. When one considers the short period during which psychology has been a subject of study in its own right, one need not wonder that more has not been
accomplished or that there is disagreement among the students of this subject.

The definitions of attention are numerous, but are not particularly satisfactory. They represent the concepts of their writers about attention, and are limited or colored in some instances to fit these concepts. Some writers even deny the validity of a concept of attention because attention is a larger or smaller part of every conscious physiological and psychological act or activity. For this reason, these writers deny that attention can be separated from the rest of an act without distorting both; but, to the writer of this thesis, this position is untenable because skill in giving attention can be taught and such teaching serves a most useful or even necessary purpose in the life of the individual. The concept is, therefore, valuable; and should not only be allowed, but should be studied with vigor and persistence. This writer likes the definition of attention, once it is understood, which states that "attention is the focusing of consciousness." This not only explains the concept, but serves as a foundation for its further study as far as one may care to go. It is obvious that, since so little is known about attention and since it is so ever-present and so useful, a great deal more study should be given the subject.

The relationships between attention and interest are
not at all well known at the present time. The comprehension of the concept, interest, is even less satisfactory than that of attention. In any one situation, the presence of interest may stimulate further attention, but, if attention is present first, it may stimulate interest. This reciprocal stimulation may continue until competing interests, fatigue, or boredom enter the situation or until one comes to believe that the rewards do not justify the effort.

The relationships between attention and consciousness are even more vague because so little is known about consciousness, even though it is ever-present throughout life, that any concept or concepts about it must be most vague. The necessity or desirability of such a concept is even denied, consciousness being held to be synonymous with life. Whether consciousness and life are identical or inseparable in practice or not, they are separable in the formation of concepts; and much more knowledge about both is most desirable.

While a great deal of knowledge is available about intelligence, almost nothing has been done in the study of relationships between attention and intelligence. Intelligence has been said by one writer to consist of the ability to pay attention well or poorly as the case may be, but that appears to be oversimplification and to involve the
omission of much established material. It seems incontestable that there are relationships between attention and intelligence, and it is probable that much could be discovered about them relatively easily.

Whether or not attention exists, it has received a tremendous amount of consideration in the field of applied psychology. Millions of dollars and great amounts of thought and planning are devoted annually to the influencing of the attention of the buying public and to economies in production through greater work output without greater fatigue or with less fatigue, with better morale, and with decreases in accidents and illness among workmen. While many of the studies of attention made in the field of applied psychology have been either rule-of-thumb or artificially "scientific," that is, so formal that no vigor was left in them, others have been excellent. A subject which does not exist would hardly receive so much attention and so many funds.

A topic which deserves much more study than it has yet received is the relationship between attention and the various psychopathological states of mind. Without doubt, thousands of observations of attention among the mentally ill have been made; but very little of a scientific nature has been published on this subject.

*Inner speech* probably accompanies all thought and all
silent reading, yet relatively few studies have been made of inner speech and fewer still of its relation—probably reciprocal—to attention.

There is little agreement, and not a great deal of interest, about the three commonly designated attentions and whether they differ in degree or in kind. Many textbooks in educational psychology do not even mention them, and many do not mention attention at all, or, at best, give it only two or three paragraphs. Many of the textbooks of fifty years ago gave the subject many times that amount of space. The three kinds or degrees of attention usually accepted are: (a) involuntary, (b) voluntary, and (c) nonvoluntary attention. Numerous other names have been given to each. Involuntary attention is short, comparatively effortless, and is given to sudden, extreme, and apparently, to certain natural stimuli. It is most useful to primitive man. Voluntary attention is comparatively short, effortful, and is usually given for some reward outside of the activity itself. It is the attention of the young child or the novice in an activity or study. Nonvoluntary attention is comparatively long, comparatively effortless, and given by reason of interest or habit. It is the attention of the more mature individual or the person skilled in some activity or study. These attentions merge into one another, and the individual fluctuates from
one to another as seems most profitable to him, or as circumstances force him to change from one to the other. All three kinds are subject to training as to direction and degree.

During the period of mechanistic and behavioristic emphasis in psychology—and occasionally still—considerable importance was attached to the distinction between peripheral attention and central attention and the alleged necessity for deciding that all attention was one or the other. Peripheral attention lies outside of the central nervous system and involves the sense organs and the afferent nerves on the one hand, and the muscles, the glands, and the efferent nerves, and, to the extent the situation seems to require, the autonomic nerves on the other. These mechanistic and behavioristic psychologists would allow little or no selection among stimuli for the person to respond to, but even the most commonplace observation will demonstrate such selection. Moreover, this selection of all except the most sudden, simple, or extreme stimuli requires neural action beyond the powers of the peripheral organization. It must, therefore, occur in the central nervous system; and, if of extensive complexity, in the cerebrum. The cerebrum has the power to analyze, select, and organize a stimulus-response situation; but it has no power to receive stimuli direct from the
environment nor to execute the desired responses. For these reasons, both peripheral and central or cognitive (afferent from the sense organs to and including the cerebrum) attentions and motor attentions are requisite to the interaction between the organism and its environment.

Studies have been made on the qualities of concentrated, as contrasted with alternating or divided attention. These are differences in degree and direction rather than differences in kind. One passes from one to the other as seems most desirable in the situation.

Concentrated attention is a large amount—perhaps all that one can muster—of attention to one stimulus or activity (either predominantly mental or predominantly physical), usually for a longer period of time than just an instant. It involves the ignoring of stimuli not relevant to the problem at hand. Alternating, or fluctuating, attention usually involves less concentrated attention which moves back and forth among two or more partial stimuli, under, or independent of, the control of the individual. The attempted solution of a puzzle illustrates controlled alternating attention. The staircase, or the windmill illusion, illustrates uncontrolled and uncontrollable alternating attention. Divided attention may involve a large or a small amount of attention given to several stimuli or reactions at once. The skilled typist, for
example, who can type and who can solve problems in mental arithmetic at the same time, supplies an illustration of divided attention, although many less formal illustrations are available. There have been discussions seeking to show or to disprove that divided attention is really alternating attention. Additional experimentation is needed, rather than more discussion, to demonstrate the correctness of the one position or the other. Other writers have held that concentration and distribution of attention may very well be the extremes of one quality rather than differences in kind.

In the study of the amounts of similar or dissimilar material which can be comprehended in very brief intervals of time, the visual sense has usually been employed and the exposure made by means of a tachistoscope. The auditory sense should receive similar study. In the visual studies, it has been found that contrast and change of color from one stimulus-situation to the next, or within a single stimulus, are important in the extent and the accuracy of the perception, while color brightness and color saturation are relatively unimportant. Size and form have been found to be important in gaining attention, while position and pattern are not. Visual imagery has been found to be of little aid in the amount or the accuracy of such perception. It has been found that all of the parts of a perception may
be grasped accurately while the whole—as a whole—is not grasped until the parts have been put together either actually as a check upon the perception, or mentally.

Some writers have tried to divide attention into two general levels—clear and unclear. Other terms meaning about the same thing are focal and marginal. While such a conceptual distinction might be useful in some experiments, practically—it would seem—the two terms are the extremes of one continuum, and should be basically so regarded.

Other writers have pointed out, largely in connection with automobile and airplane safety, that high speed in attention is not important in daily life after one goes above the slowness of the novice or the uninterested person. Even here, the partial grasp of the situation, the omission of the important cues, the attention to the unimportant cues, and the uncertainty of response or the wrong response, are probably more important than the slowness of attention if, indeed, these are separable either in practicable theory or in application. Some attention has been paid to the fact that stimuli exposed for very brief times only may be "grasped" but not more than grasped, whereas those exposed for longer times may be analyzed.

One writer believes that general intelligence may be only the ability to pay attention successfully, but this is
doubtful even though the two are closely related. He states the belief that there may be no differences in the nature of attention, but there may be in the rate and the intensity of attention at any one moment. Different tasks call for different adaptations of attention, dependent on the additional psychic and physiological equipment employed, but little which was specific has been stated about these different adaptations. It is obvious that the genius, the average, and the feebleminded vary in the intensity, duration, span, rate, and selectivity of their attentions, but the factual conclusions from careful experimentation in this area are few indeed.

While the feebleminded ignore the great majority of stimuli surrounding them, the average person and the genius not only can, but should, develop habits of not paying attention to certain persistent but irrelevant and unwanted stimuli and all other stimuli which interfere with the successful performance of the task in hand. The exclusion of irrelevant sensory stimuli and mental associations is almost as important as the selection and inclusion of the relevant stimuli and wanted associations. This skill is subject to training and can be brought to a high degree of perfection.

The effects of distractions, as distractions, have been extensively studied. Their effects vary among
different people, or with the same person at different times. Habit influences these effects greatly. Under continuous conditions of distraction, the effects may increase or decrease even to the point of ceasing to exist as distractions; or, on the other hand, they may continue to increase to the point at which the person is unable to continue his work. Working in the presence of distractions requires more effort than working under normal conditions. Small regular, or regularly occurring, distractions may bring about greater production; but small irregular distractions, large regular distractions, and large irregular distractions especially, almost always cause decreases in the volume and quality of output.

Kretschmer's theories of body-types and their psychological counter-types have been largely abandoned. Several studies made of the qualities of the attentions of these body-types proved to be unproductive of results of any value.

Mathematical curves of the fluctuation of attention have been worked out to the satisfaction of several writers. These were claimed to measure—largely, at least—the influence of fatigue. It is more probable that these curves were influenced by boredom and monotony. It was claimed that these curves cut across or were relatively uninfluenced by either rest periods or the effects of practice.
The duration of attention increases or becomes longer with age and maturation when the tasks given are complex enough to hold the attention, but the duration of attention becomes shorter as maturation increases if the tasks are simple. Intelligence among young children is not closely related to the durations of their attentions. The idea of attention-ages, comparable with mental ages, has been advanced; but the measurement of attention will have to be greatly improved before the establishment of this idea becomes practicable. With the current rough approximations of attention-ages, however, it is obvious—or should be—that demands for attention from children should not exceed very much their capacities for attending. Only by such extensions of demand does the power to attend improve in duration, however. Attention has been shown to change from the purely involuntary form to the partially non-voluntary form as maturation increases. Several studies show that the activity of the attentions of preschool children should be promoted in order to give them an advantage after they enter school. This should be done (a) through interest and effort, and (b) through learning to resist distractions. Concentration is not a gift; one must work at it in order to develop it.

The attentions of girls have greater duration than those of boys; or the attentions of boys have greater
duration than those of girls, depending upon the author read. Introversion and extroversion have been largely abandoned as concepts except for the extreme cases in the hands of the clinical psychologists, but the belief has been presented that these qualities are more closely related to the duration of attention than intelligence is--among children. The rather general observation, based on some study, has been made that dependent, defective, and delinquent children attend somewhat differently from each other and from normal children. Much more study is needed in this area.

Experimental studies have shown quite distinctly that visual attention and auditory attention are frequently widely different. Classes, therefore, should be conducted in such a way as to present material to both senses. Warning signals in danger areas should also stimulate both senses. Another study has shown that the concentration of attention increases the alkalinity of the saliva, while daydreaming decreases it.

Among the values and applications derived from the study of attention, numerous important conclusions may be presented. In any formal or informal learning situation, directed attention has been shown to be at least twice as efficient as undirected attention, in relatively simple learning experiments at least.
Supplementary learning aids have been demonstrated as useful in producing more learning under conditions of directed learning but not under undirected learning (unless they are detected accidentally by the learner).

The attentions of workers in automatic activities have been shown to be different from those of workers in selective activities while they are at work. Cognizance should be taken of this in job placement, and individual differences should also be taken into consideration. Persons with average intelligence show considerable correlation between their skills in cancellation tests and typing, copying, and adding as vocations. These correlations become negative when people with more than average intelligence are used in such vocations, probably due to their dislike of monotonous work.

Pupils in vocational classes should be taught to work under conditions of distraction similar to those to be encountered in their future employments. The fatigue of attention and the hygiene of attention are important industrial problems, but very little scientific study has been made of them.

Since the average American adult has been held to spend forty-five per cent of his active time in listening, he should be trained in efficient listening, that is, auditory attention. Rapidity of accommodation of attention
to new tasks is an important industrial problem to which inadequate study has been given. The control of attention as desired in industry and the duration of attention upon the work itself have been found to be considerably less among adolescents than among skilled adult workers. This might lead to the development of attention quotients in industry as well as in the classroom. An attention quotient is the number of minutes during which the individual or the group is at least apparently paying attention divided by the total number of minutes during which he or they are expected to pay attention. It has been suggested that different industries may require different kinds and directions of attention and that, for this reason, different tests and different training programs should be developed wherever they promise to be useful. The eye camera has been found useful in recording movements of the eye in industry as well as in looking at advertisements and reading for the purpose of study in the measurement of the attention.

In the study of the neural aspects of attention, it has been shown that attention requires the adjustment of the accessory sensory apparatus in order to facilitate the reception of expected stimuli and the exclusion of undesired stimuli. Attention also requires the innervation of a very diffuse set of musculature which plays no direct
role in the situation, but does serve, probably, to drain off neural energy from inappropriate pathways which would cause interference with the successful completion of the response.

The flow of blood through the cerebrum has been found to be larger during periods of attention than during periods of muscular work, but the meaning and the importance of this remain to be discovered. Encephalographic recordings of people occupied with socially disjunctive (worrisome) mental content show different amounts of cerebral energy output and different wave patterns from those of people occupied with mental content which is free from worry. These electroencephalographic readings should be valuable to psychiatrists in the comparative study of normal people not under strain, normal people under strain, and neurotics of various kinds. Studies have shown that concentration and distraction affect even the vegetative nervous system and the reflexes. It has also been shown that the intensity of attention also affects the breathing rate and the types of imagery as well as the electroencephalographic readings. The latter are unreliable guides, at present at least, to the degree of concentration.

In the study of the more strictly sensory fields, it has been shown that ease or difficulty of seeing an object affects the willingness to pay attention to it. Intensity
of attention in the visual field increases auditory sensitivity, influences breathing, and changes the electrical (galvanometric) resistance of the skin. It has been shown that distractions and worry lower the quality of visual performance. When visual attention is directed to the whole visual field, as opposed to a visual point of fixation, the quality of the visual performance generally improves and the threshold of visual discrimination is lowered. Studies have shown that imagery types are independent of "total" or "discrete" directions of attention, that is, looking at the whole of a stimulus or looking at it part by part. This is not the same problem as that of concentrative (concentrated) as compared with distributive (distributed) attention.

It has been shown that the fluctuations in auditory attention resemble, in their occurrence, those in visual attention. Both are influenced by the quality of the attention given. There is direct contradiction between experimenters about the possibility of lowering the auditory threshold by attentive practice. Some say that attentive practice does lower the threshold; others say that it does not. Similarly, some writers have stated that no amount of attentive practice will overcome the rapid adaptation of the tactual sense organs to liminal stimuli and the disappearance of the stimulation. No writers, as
far as this writer knows, have taken the opposite view. In industrial psychology, it has been shown that high temperatures, high wind velocities, and high humidity decrease attention and work output. It is possible that low extremes of these would also bring about similar reductions. It has been found that a combination of uncomfortable temperature, wind, and humidity has more effect than any one of these alone, even when each in combination is less in difference from normal than each taken alone.

Studies have shown that fatigue has a limiting influence on attention and upon the effectiveness of attention, but that mild fatigue may improve the performance of attention—probably through compensatory effort. Attention and productivity may be increased under conditions of emotion, even under strong emotion—but not panic—if the necessity for accomplishment is present, or is believed to be present, and if there is, or appears to be, at least a reasonable hope for a satisfactory solution to the situation. Several studies showed that mild shock, either actual or expected in a pattern unknown to Subjects, produces emotional conditions, physiological changes, and fluctuations of attention; but the effects on productivity were not reported. Anxiety and timidity have been shown to reduce productivity or the effectiveness of attention.

Among the psychoneurotics and the more severely
mentally ill, disturbance of the attention is one of the main pathological symptoms. This may take the form of extreme absentmindedness, forgetfulness, fixations, incapacity for concentration, badly selected associations, unstable attention, unusual fatigability of attention, and other abnormalities. The war neurosis cases are characterized principally by early and easy exhaustion of attention.

The effects of alcohol on attention are to make it slower, less accurate, and less well organized; but the effects are variable among individuals. The qualities of the attentions of people with concentrations of alcohol in their blood have been shown to resemble those of neurotics. The one experiment, which was noted, upon the effects of benzedrine as a stimulant on attention was inconclusive since practice effects were not eliminated before the drug was administered. The plan of the experiment involved the employment of benzedrine pills with some of the Subjects and neutral pills with others in an otherwise equivalent experimental situation.

Among stutterers, the stronger the attentional set toward avoidance or halting of the stuttering, the greater the probability or the more the prolongation of the stuttering. This is very much subject to individual variation, however.

The attention spans of the feebleminded are obviously
so small and their durations of attention so short that they have not been written up—as they should be. The quality of the attention of the feebleminded is roughly parallel to the degree of feeblemindedness, but it may be either lethargic or bird-like. In either case, it is unproductive. A few incomplete studies of a small number of individuals appear to show that otherwise intelligent children may have the attentional ability of the feebleminded only, but the number of cases was small and the investigation was not reported thoroughly.

Now that all of the foregoing has been written, one author, Easley (53), may be cited who questions the position that tests of attention actually measure attention. So far from causing one to discredit all of the material presented here, it should cause one to desire the formulation of suitable tests which will measure attention and its various facets in a satisfactory manner. Factor analysis may be the key to such a formulation, or formulations, of several types of tests of the—possible—several kinds of attention.


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