JOURNAL OF VERBAL LEARNING AND VERBAL BEHAVIOR 17, 721—743 (1978)

Richard Semon's Theory of Memory

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In the first decade of the 20th century, Richard Semon put forward a theory of memory that anticipated numerous recent developments in memory research. The theory is discussed both in its historical context and with reference to modern ideas. Semon's theoretical concern for retrieval phenomena is particularly noteworthy. Several reasons are suggested why the theory is virtually unknown today.

Current research in the area of human memory owes many of its present orienting attitudes and research techniques to pioneering psychologists of the late 19th and early 20th centuries. Among the most well known and important of these early investigators are Hermann Ebbinghaus, who performed the first systematic laboratory studies of human memory; William James, whose distinction between primary and secondary memory is still today the target of much research and theorizing; G. E. Müller, who performed important early research on grouping and interference; and Sir Frederic Bartlett, whose reconstructive approach to memory has become influential in recent years. It is likely that most modern students of memory are familiar with the writings of the above psychologists, and have probably been influenced, to varying degrees, by their research and theories. It is much less likely that these same students of memory are familiar with the work of Richard Wolfgang Semon, a German scientist who wrote two books on the subject of human memory in the first decade of the 20th century. In fact, Semon's work has been almost completely ignored by mainstream psychologists concerned with processes of memory and learning; later in this paper we will explore some of the reasons why Semon's work has been bypassed. Yet prominent anatomist J. Z. Young (1965, p. 288) commented that "...many modern ideas on the subject [of memory] go back to Richard Semon...;" Gestalt psychologist Kurt Koffka (1935, p. 598), though refraining from discussing Semon's theory in detail, noted that "...this omission is not due to a lack of appreciation of Semon's great achievement;" Nobel Prize winning physicist Erwin Schrödinger (1964, p. 44) regretted that a physiological model of Semon's theory of memory had not yet been developed "...important though it would be for the advancement of our knowledge;" and Bertrand Russell who, in a chapter in *The Analysis of Mind*, introduced Semon's work to English readers, flatly stated that, "The best writer on mnemic phenomena known to me is Richard Semon..." (1921, p. 83).

What in Semon's work elicited the accolades of the distinguished scientist-philosophers mentioned above? It is the purpose of the present paper to explore in some detail Richard Semon's analysis of human memory, place this analysis in its

This paper was written while Daniel Schacter and Endel Tulving were visitors at the Department of Experimental Psychology, University of Oxford. The work was supported by a National Science Foundation Predoctoral Fellowship to D. L. Schacter, University of Toronto Predoctoral Fellowship to J. E. Eich, and by the National Research Council of Canada, Grant No. A8632 to E. Tulving. We thank Margaret Boden, Douglas Hintzman, Gregory Jones, and George Mandler for helpful comments on the manuscript. Requests for reprints should be sent to Daniel L. Schacter, Department of Psychology, University of Toronto Toronto, Canada, M5S 1A1.

0022-5371/78/0176-0721$02.00/0

historical context, and elucidate some of the reasons why Semon's work is virtually unknown to present-day students of human memory. It is our thesis that Semon's analysis anticipated many current research problems and approaches to the study of memory in a most striking fashion, and that his work contains potentially valuable suggestions and implications for contemporary researchers.

The Background

Richard Semon was born in Berlin on August 22, 1859. His father Simon was a stockbroker; his older brother Felix became a prominent laryngologist in England, received a knighthood in 1897, and was appointed physician to King Edward VII in 1901. Semon was awarded his Dr. Phil. for zoological work at Jena in 1883, and earned his Dr. Med. in 1886. During this period, Semon studied with some of the most prominent scientists of the day, including the noted biologist Ernst Haeckel; Haeckel's emphasis on the theoretical unification of diverse biological phenomena had a particularly strong influence on Semon. After receiving an associate professorship at Jena in 1891, Semon led a successful biological expedition to Australia from 1891–1893 (Semon, 1899). He left Jena in 1897 for personal reasons, and established himself as a private scholar in Munich.

It was during this period that Semon published his two books on memory: *Die Mneme* (1904) (translated into English as *The Mneme* in 1921) and *Die mnemischen Empfindungen* (1909) (translated as *Mnemic Psychology* in 1923).[1] *Mnemic Psychology* is devoted completely to the analysis of human memory. However, in *The Mneme*, Semon examined not only the phemomena of human memory but also advanced and attempted to support the thesis that the mechanisms of memory and heredity are identical. As we shall argue later, advocacy of this thesis, that also led Semon to support the highly controversial Lamarckian doctrine of the inheritance of acquired characteristics, proved to be a key scientific error. At Easter 1918, Semon's wife succumbed to a long illness. Severly disturbed by this loss, shattered by the collapse of his native Germany in World War 1, and deeply disturbed about the lack of recognition of his work, Richard Semon ended his own life on December 27, 1918.

Before we move on to a consideration of Semon's work and its historical context, it will be useful to clarify two points. First is the problem of terminology. Semon believed strongly that everyday terms commonly used to talk about memory had too many undesirable connotations to be of precise scientific value. Accordingly, he invented his own terms to correspond more exactly to his intended meanings. One of Semon's terminological creations, the word "engram" [defined by Semon as "... the enduring though primarily latent modification in the irritable substance produced by a stimulus..." (1921, p. 12)] has persisted in present-day usage, and is probably most closely associated with the famous paper of Lashley (1960). Another of Semon's creations, the term "ecphory" [defined by Semon as "... the influences which awaken the mnemic trace or engram out of its latent state into one of manifested activity..." (1921, p. 12)] has been used quite infrequently. Since "engram" is roughly equivalent to the phrase "memory trace" and "ecphory" is roughly equivalent to "retrieval" or "recall," we will use these terms interchangeably throughout this paper.[2] We will, of course, define all new terms as they arise.

Second, when we speak of the "historical context" of Semon's theories, we refer specifically to the period from 1885–1935. Con-

[1] We will cite the English versions of these two books throughout this paper. Although we will quote most extensively from *Mnemic Psychology*, the reader should bear in mind the most of Semon's major ideas concerning human memory date to 1904.

[2] It is possible to distinguish between ecphory and retrieval, as noted in Tulving (1976). We will not concern ourselves with the distinction in the present paper.

sideration of memory research during this period will enable us to describe the theoretical concerns of the field in both the years preceding and following publication of Semon's work. We chose the year 1885 to initiate our historical consideration because this was the year in which Ebbinghaus published the first experimental studies of memory; we terminate our historical survey in 1935 because in subsequent years interest in the general problem of memory gave way to the more restricted concerns of the verbal learning tradition before surfacing again in the early 1960s.

Preliminary Overview of the Theory

Semon's theory of memory was based upon two fundamental postulates, which the author termed the "Law of Engraphy" and the "Law of Ecphory." The first law was Semon's characterization of memory storage: "All simultaneous excitations...within our organisms form a connected simultaneous complex of excitations which, as such, acts engraphically, that is to say leaves behind it a connected and, to that extent, unified engram-complex" (1923, pp. 159–160). There are several points contained in this law that subsequently emerge as critical features of Semon's theory. First there is Semon's emphasis on the unitary, wholistic nature of engram complexes that he later applies to the analysis of various mnemonic phenomena. Second there is the notion that each event, or corresponding "simultaneous excitation-complex" leaves behind a separate engram-complex; this idea is elaborated upon and utilized in Semon's analyses of repetition effecfs and recognition. The law of engraphy also sets the stage for Semon's law of ecphory, which represents his view of memory retrieval: "The partial return of an energetic situation which has fixed itself engraphically acts in an ecphoric sense upon a simultaneous engram-complex" (1923, p. 180). Thus Semon's view of retrieval is redintegrative. Only *part* of the total situation at the time of storage need be present at the time of recall in order for retrieval of the original event in its entirety to occur. This view of retrieval (one of the very few such views that had been explicitly formulated in Semon's time) was further developed and utilized by Semon in analyses of problems such as association by contiguity vs association by similarity and the temporal organization of memory, and led Semon to formulate novel positions concerning matters such as the active role of ecphory in establishing new engram-complexes and the role that ecphory plays in the storage of new engram-complexes. Also, by allowing for the representation of internal or "energetic" stimuli in engram-complexes, Semon was able to offer surprisingly modern statements concerning phenomena such as state-dependent retrieval. We will explore these points in greater detail shortly.

A third notion that is part of the kernel of Semon's theory (although it was not granted the status of a "law" by Semon) is the concept of homophony. Homophony may be most simply viewed as a resonance metaphor; Semon used it to describe the mechanism by which information from different sources is combined, defining it as "...the concordant action of closely allied mnemic and original excitations, a consonance which I have found it convenient to call *Homophony*" (1921, p. 13). Homophony can exist between two "original sensations," between "original and mnemic sensations," or between two "mnemic sensations." This resonance principle was invoked by Semon in constructing what we might want to call "retrieval explanations" of repetition effects and problems of recognition; he also applied it to various problems of perception that will not concern us here. The major point that we wish to extract from this highly condensed overview of Semon's position, and which we will document more fully later in the paper, is that the analysis of retrieval was one of Semon's principal theoretical concerns. More specifically, we will

argue that Semon's focus upon the *conditions, functions,* and *processes* of retrieval[3] was one of the few systematic attempts to elucidate the role of retrieval in memory during the period under consideration, that his ideas about retrieval anticipated much modern research, and that his emphasis on retrieval phenomena at a time when few were interested in this problem may well have contributed to his subsequent obscurity.

Memory Research between 1885 and 1935: A Brief Review

In this section we sample the memory literature between 1885 and 1935 in order to convey a general idea of the problems and theoretical issues that concerned memory researchers of the time. We will consider in somewhat more detail research that examined specific problems of interest to Semon in the next section of the paper.

One useful indicator of research concerns in a given period of time is a listing of the topics considered in major review papers of the area. Accordingly, we have examined the topics covered in major reviews of memory published in the *American Journal of Psychology, Psychological Bulletin,* and *Psychological Review* during the late 19th and early 20th centuries. First we will examine papers published before and during the time that Semon wrote his two books; then we will examine papers published after this time and up until 1935.

The first major review of theory and research on memory was Burnham's (1888–1889) classic four-part article. The first two parts covered theories of memory from the Greeks into the 19th century. Some of the important, recurring issues during this period of time were whether memory is physical, psychical, or "of the soul;" the relative importance of different kinds of assocation; the role of habit in memory; and so on. More recent topics of interest, discussed by Burnham in the latter two parts of his paper, include the physiological basis of association, the effects of retention interval on forgetting, the usefulness of memory span as an indicator of educability in normal and retarded children, and the nature of "memory illusions." Of course, Ebbinghaus' pioneering work had just been published. This initiated serious experimental interest in the study of memory and brought the study of repetition effects and the quantification of forgetting curves to the fore of the field. Interest in problems of retrieval, however, was negligible in the years covered by Burnham's review. With the exception of Sir William Hamilton (1859), who explicitly divided memory into three stages of acquisition, retention, and reproduction, and offered an early redintegrative theory of retrieval, and some passages from William James (1890), these early writers had little direct interest in either the functions, conditions, or processes of retrieval.

Kennedy's (1898) review reflects the emerging concerns of the young experimental science of memory. After discussing methods and materials used in memory research, Kennedy outlined the problems of interest to contemporary researchers: measurement of the depth of "initial impressions," the role of attention and repetition, the qualitative change in the memory "image" over time, individual differences in memory ability, and the nature of the to-be-remembered material were all major issues of the day; and the initial investigation of grouping and organization had just been reported by Müller and Schumann (1894). In Kuhlmann's (1908) review (which appeared just after *The Mneme* and just before *Mnemic Psychology*) we

[3] The phrase *processes of retrieval* refers to the mechanisms by which retrieval is carried out; the phrase *conditions of retrieval* refers to those properties of the cognitive environment of the rememberer which affect the retrieval process; and the phrase *functions of retrieval* refers to the effects that the act of retrieval has upon the subsequent state of the memory system.

observe continued concern with many of the topics reviewed by Kennedy, and observe heightened interest in problems that had been barely touched at the time of Kennedy's review. For instance, the problem of massed vs distributed practice, first attacked by Ebbinghaus, was now a major research concern; the introspective analysis of the "memory consciousness," concerning the form and content of memory imagery and individual differences in this imagery, had "...come to the foreground of memory investigation" (p. 285); and the analysis of recognition was becoming a full-fledged experimental problem. But again there was a remarkable absence of attention paid to problems of retrieval. In the years before and during which Semon published his two volumes on human memory it is extremely difficult to find any theory or research that raises questions specifically directed at the conditions, functions, or processes of retrieval. Association was assumed to be the mechanism of the retrieval *process*, an assumption the Semon criticized elegantly, and that we will examine shortly; there was interest in retrieval *conditions* only insofar as the laws of association required some specification of effective associative stimuli; and the possible mnemonic *functions* of the act of retrieval itself were simply not considered by theorists of the time. (For a more detailed account of memory research during this period, see the paper by Murray, 1976).

We now move ahead to the 1920s and consider the lengthy review paper by Robinson (1924). Robinson's paper was divided into five major sections. The first section, on "memorizing," considers many of the topics previously mentioned, as well as the role of intention in learning and studies of associative inhibition, for example, the Ranschburg effect. The second section, concerned with retention, reviews several topics that had not previously been given much attention. Studies of retroactive interference, which originated in the classical work of Müller and Pilzecker (1900), are now well under way; the problem of affective tone and retention, owing largely to Freudian influences, has become a major research topic; and the problem of reminiscence, first addressed in Ballard's (1913) monograph, has been given experimental attention. We also find reference to studies comparing the effect of recalls vs extra study presentations on retention; that is, studies exploring the *functions* of retrieval. The third section of Robinson's review, entitled "Recall," indicates just how sparse research in this area was. A few studies that examined various aspects of legal testimony are cited, and one study (Laird, Remmers, & Peterson, 1923) that was concerned with retrieval *conditions* is mentioned; but the problem of recall is still clearly of minor experimental and theoretical interest at the time of Robinson's review. The remaining sections of his review cover qualitative studies of memory, and memory in the "insane and defective."

The final reviews we will consider were published by McGeoch (1928, 1930). The topics reviewed in these papers, as well as many of the studies we have already made reference to, are brought together in McGeoch's (1933) massive, 1200-item bibliography of learning and memory research. These reviews reflect heightened interest in serial postion effects and problems of transfer; a new concern with the establishment of general laws of learning; and continued interest in traditional problems such as quantification of the curve of retention, the most economical methods of practice, the role of sensory modality in memory, etc. As regards analyses of retrieval, several studies of the similarity of "stimulating conditions" (i.e., context) at storage and retrieval are considered, as are several studies of successive recalls; but the largest number of studies concerned with recall are found under the heading of "Relationships between different measures of retention" (McGeoch, 1933, p. 57). These studies, best exemplified by Luh's (1922)

work, reflect the common attitude of investigators at the time towards the issue of retrieval: It is viewed as a problem of *measurement*, rather than as a psychological process that forms a crucial part of the memory system and that requires systematic theoretical analysis. Serious theoretical consideration of retrieval and its role in the memory system was to emerge shortly in the work of Bartlett (1932), Köhler (1930), and Koffka (1935), before disappearing for the next 30 years; but with few exceptions (such as Hollingworth, 1926, 1928; Meumann, 1913; Selz, 1913, 1922; and to some extent, Myers & Myers, 1916) the problem was treated in an almost uniformly atheoretical fashion in the years preceding and following Semon's work.

Additional evidence on this point can be adduced by sampling general theoretical statements made about memory in the period under consideration. For instance, there was William James' (1890, p. 653) view that "... *the cause both of retention and of recollection is the law of habit in the nervous system, working as it does in the 'association of ideas'*." Kennedy, in his 1898 review, reduced memory to two factors: "...the conditions which govern the chances that a certain object be remembered depend, first, upon the depth and clearness of the impression which that object made on me in my experience of it, and second, upon the transformation which my image undergoes in the temporal flow" (p. 485). Thorndike's (1913) proclamation provides a typical textbook view of memory around Semon's time: "Goodness of memory depends upon the permanence of impressions, the permanence of connections, their number and their nature or arrangement" (p. 25). The neglect of retrieval factors in the above formulations is clear, and these statements are quite typical of memory theory at the time. We will refer to some of the individual experiments and ideas that were directed at retrieval phenomena in the next section of the paper. The major purpose of the present section, in addition to providing a general characterization of research interests between 1885 and 1935, has been to demonstrate the relative lack of theoretical concern for the problem of retrieval throughout this period.

Semon's Theory in Historical Perspective: A Detailed Analysis

We now proceed to a more fine-grained exposition of Semon's theory. As we consider the various aspects of Semon's theoretical postion, we will relate his formulations to the theories of his contemporaries, and will also juxtapose Semon's views with those advanced by modern students of human memory.

Biological Perspective

We initiate the discussion by considering the *substrate* of engraphy: how did Semon conceptualize the representation of engrams? It may be advisable first to remind the reader that, in the early part of the 20th century, the question of whether memories are represented in the brain (that is, physically) or in the mind (that is, psychically) was a hotly debated issue. Eminent thinkers such as Bergson (1911) and McDougall (1911) argued at great length that memories are not physically represented in the brain but rather in some nonphysical, "psychical" form. Semon's view on the matter reflected his biological training; he unequivocally took the postion that engrams are stored via physiochemical processes in the brain. However, Semon declined to hypothesize about the precise form of this biological storage, arguing that in the limited state of then contemporary physiology, such speculation was unwarranted. Semon did go on to raise the question of whether memory storage is neurologically *distributed* or *localized*, and offered a surprisingly modern view (see, for example, Luria, 1973):

> We seem ...to be placed in the dilemma of having either to reject altogether a localization theory which imagines that each single engram can be stored up in a single cell—or in a comparatively

> small complex of cerebral cells... or to admit that in the human organism a special interdependence exists between definite regions of the cerebral cortex and the ecphory or, as perhaps we ought to say, the possibility of the ecphory of distinct individually-acquired engrams. The latter admission, implies, however, the recognition of a certain localization, although it need not be the kind which makes each nerve-cell of the brain a repository for a specific engram (1921, p. 120).

It is interesting to note the manner of criticism directed toward these views. On the one hand, Semon was grossly misinterpreted and accused of one of the worst scientific sins of the day: the advocacy of vitalism. Since he did not construct a model which specified the precise nature of biological memory storage, and because he did not adhere to a strict localizationist view, various critics (e.g., Kostyleff, 1911) attached the vitalistic label to Semon's position. To these critics, Semon gave an incisive reply which merits close attention even today:

> I should be as able as anyone else to turn out some sort of schematic representation on the model of the diagram of Mendelian determinants in which engrams would be naively represented, schematized as tiny particles and conveniently packed together. This would meet the views of those readers whose thirst for causality requires such schematic representation, and who cannot resign themselves to leaving such questions open for the time being. My own conception of inductive science is a different one, and I attribute more value to an honest note of interrogation than to constructions which are only representable through an effort of imagination (1923, p. 329).

On the other hand, avowedly vitalistic writers such as Bousefield (1928)—who advanced the theory that memories are not physically represented in "protoplasm" but rather are psychically represented in "psychoplasm"—accused Semon of erring by reverting to crass mechanistic reductionism. Thus, Semon was criticized by both mechanists and vitalists for espousing general hypotheses concerning the biological nature of memory storage that today seem both perfectly reasonable and appropriate to the state of physiological knowledge at the time.

Relation of Perception to Memory

Returning to Semon's view of engraphy, an important point to note is that Semon's analysis of memory was directly related to his analysis of perception:

> ... the very expression "mnemic sensation" necessarily implies that such a sensation has been preceded by an original one. The nature of this dependence will be fully explained later. The bare fact of its existence, however, makes it a precondition for the study of mnemic sensations that we should closely follow the orientation of certain aspects of original sensations, because the former depend on the latter as inevitable predecessors (1923, pp. 69–70)...

Indeed, the first part of *Mnemic Psychology* is devoted to an analysis of sensation and perception, upon which Semon's analysis of memory is based. In Semon's time, the analysis of perception was largely divorced from the analysis of memory, and with few exceptions (e.g., Külpe, 1895), explicit theoretical realization of the interrelatedness of perception and memory was not manifested until the appearance of the work of Bartlett (1932), Gibson (1929), and the Gestaltists (Köhler, 1930; Koffka, 1935). The interrelatedness of perception and memory is, of course, a major theme in contemporary research, forming an important part of numerous theories.

In order to understand the relation between perception and memory in Semon's theory, we must first briefly consider his analysis of perception. In contrast to atomistic conceptualizations of sensation and perception that were dominant in experimental psychology around the turn of the century (e.g., Külpe, 1895; Titchener, 1911; Wundt, 1902), Semon stressed the unity and wholistic nature of "sensation-complexes": "... what we experience immediately are not single sensations but connected complexes of sensation, forming at any given moment the whole content of consciousness" (1923, p. 65). Semon preferred to speak of "fields of sensation" rather than

"sensation-elements," emphasizing the "primary unity" of such fields, and he ascribed an important role to the "reciprocal influence" of the components of a field of sensation. In so doing Semon anticipated Gestalt analyses of perception and the context and contrast effects that the Gestalt theory was based upon. Similar views concerning "reciprocal influence" can be found in Höffding (1891, p. 114), and other early wholistic, Gestalt-like analyses of perception were offered by Mach (1959); but these were exceptions to the prevailing atomistic views (Boring, 1942).

Semon's conceptualization of the engram follows directly from his wholistic analysis of perception. The memory trace is to be regarded as a unified complex, reflecting the unitary nature of perceptual experience. The essence of this idea is captured in Semon's law of engraphy. However, Semon stressed that the engram is comprised of "emergent components" that could to some extent be dissociated from each other. This view, similar to recent multicomponent theories of the memory trace (Bower, 1967; Underwood, 1969), was elaborated further by Semon and will be discussed shortly. At this point the reader may rightly ask if all Semon has done is to offer another "literal-copy" theory of memory stated in Gestalt-like terms: engram-complexes are simply faithful recordings of perceptual experience, and when we remember we have access to this stored "snapshot" of the world. It turns out that Semon was saying no such thing; he in fact directly addressed the question of why the output from the memory system is so different from the input, and his answers to this question form some of the most interesting parts of his theory.

First, Semon argued that distortion is introduced into the memory trace at the time of storage. This is because every act of storage, in Semon's view, involves some retrieval: the new input acts as a retrieval cue which operates ecphorically on the principle of "partial return" described in Semon's second law. Hence, what is stored is not just a faithful recording of perceptual experience; rather "... nearly every complex of original sensations has grouped around it numerous mnemic sensations which are evoked by it and work engraphically in the grouping... every simultaneous complex of sensations is composed of original and mnemic sensations which are closely connected with one another, and thus form a whole; and this whole—regarded from its energetic side—works engraphically" (1923, p. 168).

Semon also considered the problem of why only fragments of this whole (however different from a literal "snapshot" it might be) can be remembered. Semon argued that these memory fragments are not isolated links in a semi-intact associative chain; rather, reflecting his multicomponent orientation, he suggested that "... a conception much more in accordance with our meaning leads us to regard such fragments not as associated, but as *integral components, as emergent points of a connected simultaneous complex of sensations*" (1923, p. 164). Semon's concern with memory fragments foreshadowed the recent systematic work of Jones (1976), whose "fragmentation hypothesis" of memory holds that memories are *stored* as fragments of a perceived situation. Semon offered three explanations of fragmentation, two of these reflecting his view that fragmentation arises at retrieval. First, Semon argued for the importance of retrieval conditions in fragmentation. The direction of attention at the time of ecphory influences which fragments of the trace are "noticed:" "The fixing of attention on specific points in the simultaneous complex acts as a dissolvent and dissociates these parts from the rest of the connection" (1923, p. 165). Second, Semon suggested that homophony, or resonance, between the ecphoric stimulus and certain components of the retrieved engram-complex might accentuate some fragments at the expense of others. Third, he noted that mnemic sensations are "less vivid" than original sensations; hence, only the "peaks of sensation" may emerge during ecphory.

In outlining Semon's position on the input-output discrepancies, it is clear that in most respects his approach to the problem was quite different from that of his contemporaries. The major theoretical emphasis in explanations of input-output discrepances at the time Semon wrote was on the role of unconscious processes in changing, distorting, or weakening the memory trace over time (Kennedy, 1898); this notion also played a large role in subsequent Gestalt analyses of memory (c.f., Koffka, 1935). Semon's notion that the fading of mnemic sensations contributes to fragmentation is similar to these traditional views. Exceptions to the prevailing hypothesis are found in the work of Bentley (1899) and Kuhlmann (1906), who attached importance to associations formed at storage as major determinants of input-output discrepancies. This position is in some ways similar to Semon's point that each new engram-complex is comprised of "original" and "mnemic" sensations, although Semon's conception of this process is quite different from the mechanisms envisaged by Bentley or Kuhlmann. It was not until the work of Crosland (1921) and the later monograph by Bartlett (1932) that serious consideration of retrieval conditions as causes of input-output discrepancies is found. These authors placed major emphasis on the subjects' "attitude" at the time of recall in developing accounts of distorted and fragmentary remembering. In modern studies of input-output discrepancies, the "unconscious transformation" hypothesis so popular in Semon's time has been abandoned, and research has been directed at processes of generalization, fragmentation, and abstraction occurring at both storage and retrieval (Bransford & Franks, 1971; Frederiksen, 1975; Jones, 1976; Loftus, Miller, & Burns, 1978). Additionally, the notion of "implicit associative responses" advanced by Underwood (1965) to account for false recognition data resembles Semon's idea that both incoming stimulus information and information from the memory store are represented in each new memory trace; however, the mechanisms of this process postulated by Semon and by Underwood are quite different. Thus, it seems clear that the thrust of Semon's position on the problem of input-output discrepancies was more in accord with the modern approach than was the popular theory of his era.

The Acoluthic Phase and Temporal Organization

Closely related to the perception-memory issue is Semon's distinction between the *synchronous* and *acoluthic* phases of sensation. The synchronous phase lasts only as long as a physical stimulus is present, whereas the acoluthic phase persists for some time after the cessation of the stimulus. Semon distinguished two components of the acoluthic phase: a period of short-lived oscillating activity (less than a second) which "...manifests itself regularly in sensations above the threshold of consciousness..." (1923, p. 140); and a longer lasting activity of unspecified duration that is not always manifested in consciousness. At first glance, it is tempting to say that Semon was simply talking about after-images that were the subject of some research during this time (Boring. 1942). However, closer consideration of Semon's treatment of the acoluthic phase reveals that he assigned it an important *functional* role in the overall memory process. As we shall see shortly, Semon's concern for the mnemonic functions of the acoluthic phase sharply distinguishes this conception from that of the static after-image that was not studied as a functional component of the memory system during this time.

Before describing the functional use to which Semon put the acoluthic phase, we must first outline his conception of the temporal arrangement of the memory store, for it is in his analysis of temporal relations that Semon makes use of the acoluthic phase. Semon hypothesized that the engram-store is organized primarily along temporal dimen-

sions, and that engram-complexes are deposited in "chronological strata:"

> Every simultaneous complex which may be figuratively described as one "layer" of an engram-store is joined to the layer immediately preceding it and, in its turn, bears the same relation to the next most recent layer. Owing to the uninterrupted laying down of these 'layers' the components of each layer are in immediate contact with those of its nearest predecessor and nearest successor (1923, p. 327).

Again it is worth noting that Semon concerned himself with an issue that was not of prime importance to his contemporaries. Galton (1879), James (1890), and Ribot (1882) did talk about the temporal organization of memory, but the problem was clearly not of major concern in Semon's time, as can be verified by examining the review papers we cited earlier. Semon's interest in temporal organization anticipated modern theories such as Landauer's (1975), in which time is viewed as the principal dimension of organization in memory, and experimental work such as that reported by Crovitz and Schiffman (1974), Guenther and Linton (1975), and Underwood (1977), in which various aspects of temporal factors in memory are explored. Semon's ideas on temporal organization also bear a striking resemblance to the general theory of temporal organization put forward in Murdock's (1974) conveyer belt model.

Having exposed Semon's views on the "chronological stratification" of memory, we now return to a consideration of the functional role of the acoluthic phase in the genesis of temporal organization. Semon proposed that memory traces of successive events are temporally linked by the co-occurrence of the synchronous phase of event N with the acoluthic phase of event N–1. Thus, the persisting acoluthic excitation provides the "temporal glue" permitting the establishment of unique engram-complexes comprised of the synchronous phase of one stimulus and the acoluthic phase of a preceding one. The critical point to note is that Semon did not view this process as one of "horizontal" association between successive events. Rather, the *simultaneous* conjoining of synchronous and acoluthic phases establishes a unique engram-complex. The nature of this distinction is best illustrated by Semon's explanation of Ebbinghaus' finding that remote associations exist between nonadjacent nonsense syllables in his classic study. Rather than positing a direct "horizontal" association between, say, Event X and Event Y, Semon suggested that X and Y form a new engram-complex by virtue of the simultaneous occurrence of the synchronous phase of Y and the fading acoluthic phase of X. Then, when there occurs partial return of this complex (let us say Event X as a retrieval cue) memory for the whole complex follows. Thus, in contrast to the traditional associative account of remote association, Semon offered a novel explanation based on the functional role of the acoluthic phase and on his redintegrative principle of ecphory through partial return of the conditions of engraphy.

This theory led Semon to adopt the view that all association is simultaneous; apparent cases of successive association arise through the simultaneous occurrence of the acoluthic phase of Event X and the synchronous phase of Event Y. Semon's provocative position on this matter led directly to some of the earliest experimental work explicity concerned with simultaneous vs successive association in human memory, reported by Wohlgemuth (1915). Although Wohlgemuth claimed that his results strongly supported Semon's theory, inspection of his method and data suggest extreme caution in interpretation of his results. It is interesting to note, though, that this is the only instance we have found in which one of Semon's theoretical positions on human memory was put to direct experimental test. There are, clearly, serious deficiencies in Semon's conceptualization of the acoluthic phase that hinder meaningful experimental investigation of it, for example, it is unclear how long the acoluthic phase lasts,

and how one obtains independent evidence of its existence. Accordingly, it would be fruitless to attempt to evaluate Semon's hypothesis in the light of the subsequent experimental literature (Carr, 1919; Froeberg, 1918; see also Robinson, 1932).

However, there are two senses in which Semon's conception of the acoluthic phase anticipated modern research and theory. First, Semon's ideas would fit well with recent experimental demonstations of long-persisting visual memory traces (e.g., Kroll, Parks, Parkinson, Bieber, & Johnson, 1970). Second, the conception of the acoluthic phase is in some ways quite similar to modern conceptions of short-term memory. The acoluthic phase constitutes a preliminary *stage of processing* which temporally precedes a more permanent engraphic representation, and it plays an important *functional* role in the memory system, as does the short-term memory envisaged in recent theories (e.g., Atkinson & Shiffrin, 1968; Baddeley & Hitch, 1974). Of course, there are numerous ways in which Semon's conception of the acoluthic phase has little in common with modern conceptions of short-term memory; but at a time when the major interest in short-term memory concerned individual differences in memory span (Binet & Henri, 1894; Hawkins, 1897) and the effects of varying materials on span length (Kennedy, 1898), the similarities are impressive.

The Law of Ecphory

We have already described Semon's law of ecphory, and have outlined his application of it to two problems of memory, namely, input-output discrepancies and simultaneous vs successive association. We now discuss Semon's conception of ecphory in greater detail and describe further applications of this concept to problems of memory.

As noted earlier, a key notion embodied in the law of ecphory is that of redintegration, the reinstatement of a whole via one of its parts. The classical historical reference is, of course, to Sir William Hamilton, who argued for a redintegrative position in 1859. Semon did not cite Hamilton in either *The Mneme* or *Mnemic Psychology*, and was most likely unaware of Hamilton's redintegrative position. Somewhat similar redintegrative views can be found in Höffding (1891) and Selz (1913, 1922). The most prolific exponent of redintegration in the period just following publication of Semon's work was Hollingworth (1926, 1928); more recently, Horowitz and Prytulak (1969) have refamiliarized modern students with the notion of redintegration.

Although the basic redintegrative position taken by Semon was similar to the positions of his contemporaries Höffding, Hollingworth, and Selz, there are two distinguishing characteristics of Semon's approach to redintegration. First, Semon's elaboration of his position sounds much like modern theories of retrieval in which feature overlap between retrieval cue and memory trace is granted a critical role in the retrieval process (Kintsch, 1974; Tulving, 1976): "Resemblance, that is to say, partial coincidence between the components of an actual group of excitations and those of any previous engram-complex, causes ecphory of the latter through the former" (Semon, 1923, p. 326). Although Selz advanced similar notions, none of the other redintegrationists have taken such a position. Second, Semon directly applied his law of ecphory to a variety of specific problems in the study of memory. Hollingworth did apply his redintegrative principle to various problems in psychology, especially those involving pathology, but he did not relate it specifically to memory.

Contiguity vs Similarity and the Engraphic Role of Ecphory

One of Semon's most striking and innovative applications of redintegrative ecphory to a problem of memory concerned the question of association by contiguity vs association by similarity. This problem has a long history in psychology and philosophy, with some authors arguing that all association

is by similarity, others that all association is by contiguity, and others that both forms of association occur (see Warren, 1921; Robinson, 1932). Semon took the position that all association is developed through contiguity, which in itself was nothing new; but his manner of reaching the conclusion was quite interesting, and merits close attention for two reasons. First, it again highlights the important role of retrieval processes in Semon's theory; second, it brings to light an important distinction that was largely overlooked at the time.

In order to account for apparent association by similarity (that is, the case in which Stimulus X evokes a semantically, visually, acoustically, etc., similar Memory Trace Y) Semon invoked his principle of partial return. Owing to shared components between Stimulus X and Trace Y, Y is ecphorized in the presence of X, just like in any other ecphory via partial return. It is only at this point that the two events are associated, through contiguity, and the new engram-complex is then stored. Thus Semon argued that association by similarity is due to:

> ...an ecphory based on the partial recurrence of certain components of an excitation-complex. When departing, it leaves behind a new engram-complex in which the two images are associated, but *this consecutive association is a typical simultaneous association* (1923, p. 189).

Semon went on to state that, "In fact 'association' through resemblance does not exist. What is taken for it is ecphory due to the partial return of a complex which has previously left its engram" (1923, p. 189).

There are two critical points to be extracted from this analysis. First, it led Semon to make an important distinction between *ecphory* and *association*. Association can be revealed through ecphory, but it cannot be equated with the process of ecphory. Here Semon was challenging the common assumption of his era that association *is* the *mechanism* of recall. Semon rejected this notion, preferring to think of association as a descriptive concept which should be logically distinguished from the mechanism of retrieval. By disentangling these two concepts, Semon was able to offer a novel analysis of association by similarity: "...the essential gain from our investigation is that the notion of association through likeness was based on a confusion of two concepts: association and ecphory" (p. 189). Semon's analysis is closer in spirit to modern conceptions such as encoding specificity (Tulving & Thomson, 1973) than to the theories of his time.

The second point that is brought into bold relief by this analysis concerns one of the important *functions* of retrieval in Semon's theory: the establishment of new engram-complexes. Semon argued that every act of ecphory results in the establisment of a unique engram-complex comprised of the retrieved information and information in the present context: "...each ecphory of an engram-complex produces not only a mnemic sensation ...but through this creates a new engram which adheres to the new engram-stratum" (1923, p. 178). He utilized this notion in his explanation of association by similarity presented above, and also invoked it in his consideration of how engrams from different "chronological strata" are combined. Semon suggested that when a particular engram-complex has been ecphorized, it can then act as a cue for engrams in other chronological strata with which it shares common components, and hence can be retrieved via parital return; this new juxtaposition is then stored as a unique engram-complex.

Semon's conceptualization of ecphory as a generator of novel engram-complexes was unique in its time. There was some concern with the functions of recall in the years following publication of Semon's two books, but little before. Abbott (1909) compared the memorial effects of extra recall time and study time, finding that time spent recalling is more beneficial than additional study time; Trow (1928) and Raffel (1934) came to similar

conclusions. In a slightly different vein, Bartlett (1928) and Whitely and McGeoch (1927) investigated the effect of one recall on a subsequent recall. With these few exceptions, however, the functional significance of the act of retrieval was rarely treated in a theoretical manner during Semon's time. Indeed, this characterization can be accurately applied to the period extending into the 1960s at which point serious theoretical concern with the function of the act of recall began to emerge. This concern has manifested itself in several ways. The memorial consequences of recall trials vs study trials have been pursued in a systematic manner (e.g., Izawa, 1969; Tulving, 1967); the facilitating effects of retrieval on subsequent retrieval have been the object of both experimental and theoretical attention (e.g., Darley & Murdock, 1971; Modigliani, 1976); and inquiries into the inhibiting effects of the act of recall have been made (e.g., Roediger, 1974; Rundus, 1973). Thus it would appear that Semon's early interest in the functions of ecphory anticipated a number of current research trends. It should be noted, though, that in the above studies, facilitating effects of recall are almost invariably attributed to some sort of "strengthening" process: The accessibility of an existing memory trace is increased via the strengthening effect of recall. Semon, on the other hand, suggested that what emerges after recall is not a strengthened version of an already existing trace, but rather a new, unique constellation of information in the present context plus information in the retrieved trace. The modern research closest in spirit to Semon's approach is the recent work on memory for remembered events reported by Gardiner and Klee (1976; Klee & Gardiner, 1976). These authors posit that "Each act of remembering itself ...constitutes a new event in episodic memory" (Klee & Gardiner, p. 471), and provide evidence to support this hypothesis. Further research in this area might well profit from serious consideration of Semon's ideas on the engram-establishing capacities of the act of recall.

Internally-Generated Stimuli

We noted earlier that Semon specifically allowed for representation of internal stimuli in the formation of engram-complexes, and suggested that these internal stimuli function as potent ecphoric cues. First let us consider the notion that internally-generated stimuli are stored as components of an engram-complex. This notion, which forms part of the law of engraphy, is one that very few investigators of Semon's time explicitly formulated. The notable exception is Hollingworth (1926, 1928) who in his various expositions of red-integration ascribed considerable mnemonic import to internally-generated stimuli. Research and theory explicitly concerned with the representation of internal stimuli in memory is still scant in modern times. Anderson and Bower (1973) specifically allowed for the representation of internally-generated stimuli in HAM, the mnemonic significance of inner or experiential contexts has been suggested by McGeoch (1939) and Reiff and Scheerer (1959), and experimental investigation of memory for internally-generated stimuli has recently been reported by Dosher and Russo (1976). It is clear, though, that serious research on this topic of concern to Semon is just getting under way.

Consider next Semon's position on internal stimuli as ecphoric cues: "...ecphory can arise without any recurrence of an original stimulus through the mere partial return of the inner energetic situation which was present at the formation of the engram-complex" (1923, p. 180). It is exceedingly difficult to find any experimental or theoretical work bearing on this issue in Semon's time; exceptions are found in Hollingworth (1926), and to some extent, in Ribot's (1882) book. Also, concern for the relation between internal states and memory was manifested in the clinical work of Freud (1913), Janet (1928), and Prince (1916); but the emphasis here was on exploiting the relation between internal states and mnemonic processes for therapeutic purposes rather than on developing a theoretical

analysis of memory per se that would account for the ecphoric efficacy of internal states.

One particularly interesting manifestation of Semon's interest in internal states as ecphoric stimuli is his anticipation of modern research on state-dependent retrieval (Eich, 1977). Although one can spot the outlines of this anticipation in the quotation cited above, Semon developed this position far more explicitly, noting that "... in cases where the energetic condition has greatly changed ... not even the recurrence of the original stimulus suffices for the ecphory of the corresponding engram" (1921, p. 144). This led Semon to suggest that, "Alcoholic intoxication may, under certain circumstances, create an energetic condition whose engrams are ecphorable in the next state of intoxication, but not in the intervening state of sobriety" (1921, p. 144). Semon followed this remarkably prescient statement with one that even modern students of state-dependence would have difficulty in addressing satisfactorily: "Only in cases where by virtue of the experience of years the engrams are deeply fixed and frequently ecphorized may we expect ecphory independent of abnormal or contrasting conditions" (p. 145). Does repetition attenuate state-dependent effects? Can we find evidence of state-dependence in semantic memory? Are frequently retrieved memories less susceptible to state-dependent effects than rarely retrieved memories? These issues, barely touched upon in present-day research, are intriguing and important questions about state-dependence that emerge directly from consideration of Semon's analysis.

Homophony, Repetition and Recognition

Earlier in the paper we briefly described Semon's conception of homophony as a resonance metaphor that Semon employed to describe the way in which information from different sources is combined. The following is a general characterization of homophony:

> At the ecphory of a combination of engrams ... what is given is not a single indissoluble blend of mnemic excitations—"coalescence" some physiologists call it—but a unisonant chorus in which the single components of an apparently uniform combination of engrams, distinct indeed from each other as to their time of origin, may be individually discerned (1921, p. 165).

Semon emphasized that the contributors to homophony (be they original or mnemic sensations) run a "side-by-side" course and are superposed much in the manner of individual transparencies containing different information that are placed on top of each other. He went on to distinguish two subtypes of homophony, a "nondifferentiating" homophony, in which there is a combination of the components, and a "differentiating" homophony, which is "... always the result of an antagonism between two components or two groups of components" (1923, p. 248). Whether a differentiating or nondifferentiating homophony occurs depends largely on the conditions of ecphory.

In order to further clarify Semon's conception of homophony, let us briefly consider his use of the idea in an analysis of generic vs temporally specific memory imagery. Semon argued that the ecphory of generic images (e.g., a particular house) occurs when "... all the engrams belonging to my view of the house are allowed to act homophonously" (1923, p. 277). However, with different retrieval demands, specific temporally dated images of the house may be ecphorized: "When I wish to ecphorize the images of this house I can do so by fixing my attention on a definite, temporally determined engram of the same ..." (p. 276). Thus, the information from the indiviudal engrams is combined via homophony; and whether or not homophonous resonance occurs depends on the intentions of the rememberer and the conditions of ecphory. It would be tempting to suggest that Semon was here anticipating the distinction between episodic and semantic memory (Tulving, 1972) as a utilization phenomemon; but since he did not explicitly

discuss such a distinction, such a statement would probably reveal more about our own theoretical dispositions than about Semon's thoughts on the matter. In any case, Semon's conception of homophony, although admittedly somewhat vague, again reflects his intimate concern with the nature of retrieval processes, and stands out as a unique conception in its time. There are few ideas in the memory literature of his day that bear even the remotest resemblance to Semon's conception of homophony, as noted by Becher (1910) in a review of *Die mnemischen Emfindungen*; perhaps Selz's notion of "pattern completion" (Kintsch, 1974) or Loeb's idea of association by resonance (Loeb, 1901) are the closest. Also, the notion of homophony bears a strong resemblance to the resonance metaphors of retrieval recently adopted by Lockhart, Craik, and Jacoby (1976), Moeser (1977), and by Ratcliff (1978).

What is most interesting about Semon's conception of homophony is the use to which he put it in the analysis of various memory problems. Let us specifically consider Semon's postion on the problem of repetition. The dominant theoretical approach to repetition effects during Semon's time was the *strengthening* view: Repetition exerts its beneficial effects on memory by strengthening the representation of the repeated item. This paradigmatic theory of repetition effects was stated clearly by Ebbinghaus: "...as the number of repetitions increases, the series are engraved more and more deeply and indelibly..." (1885, p. 53). In almost all studies of repetition during the time period we have considered, strengthening is assumed to be *the* mechanism of repetition effects. Of all the questions asked about repetition at the time [which include the problem of massed vs distributed repetitions (Browning, Brown, and Washburn, 1913; Perkins, 1914), rate of repetition (McGamble, 1916), and number of repetitions (Calkins, 1894)] questions and hypotheses concerning the *mechanism* of repetition effects are conspicuously absent. One exception to this prevailing trend is found in Ward's (1893) paper, in which he explicitly distinguished between "functional" (strengthening) and "atomistic" (multiple-trace) views of repetition in the context of a discussion concerning recognition and association. However, debate examining the relative merits of strengthening and multiple-trace points of view did not emerge in the subsequent experimental or theoretical literature.

It is against this background that we introduce Semon's theory of repetition effects: "Every repetition of a stimulus and, consequently, of an original excitation deposits a new engram which, if by nothing else, is distinguishable from all its predecessors by the important difference of its being an integral element of an engram-complex belonging to a new layer" (1923, p. 254). In contrast to the dominant strengthening theory of the time, Semon hypothesized a mechanism of repetition effects much closer to the recently advanced multiple-trace views of repetition (Bernbach, 1969; Bower, 1967; Hintzman & Block, 1971). Like Semon, these theorists have argued that each repetition of a stimulus creates a separate, unique memory trace. Recent critical reviews contrasting multiple-trace and strength theories have concluded that the bulk of the experimental evidence currently favors the multiple-trace hypothesis (Hintzman, 1976; Howell, 1973). However, while most modern multiple-trace theories suggest some sort of read-out of the number of stored traces as the vehicle of repetition effects, Semon had something quite different in mind. He ventured that although multiple traces are stored, the output from the memory system could be in the form of separate traces or of some amalgam of the separate traces via homophony, depending upon the conditions of retrieval. So while repetitive input to the memory system is always in the form of multiple traces, output varies, depending upon retrieval conditions and consequent homophony. Semon was quite explicit in juxtaposing his theory with the strength

theory, noting that "... if the formation of an engram through excitation were a question of mere facilitation of channels, the repetition of an excitation would, at best, only enlarge the engram, but could not create a new, distinct, isolatedly ecphorable engram..." (1923, p. 255) and stating emphatically that:

> REPETITION OF A STIMULUS DOES NOT STRENGTHEN AN ALREADY EXISTING ENGRAM, BUT GENERATES A NEW ENGRAM, AND THE MNEMIC EXCITATIONS RESULTING FROM ANY SUBSEQUENT ECPHORY ARE IN HOMOPHONY (1921, p. 169).

These statements leave little room for doubt about Semon's position on repetition effects; they also illustrate the functional use to which Semon put the concept of homophony.

In Semon's analysis of recognition, we find the notion of homophony being put to a slightly different use, and again encounter Semon's distaste for "strengthening" views of memory. By the time Semon published his two books, there already existed a substantial literature, both experimental and theoretical, on the problem of recognition (Woods, 1915).

> Many different analyses of recognition had been put forward in this literature [Woods (1915) was able to distinguish between 13 theories] and debate among theorists of different persuasions often reached highly emotional levels. Among the popular theories of the time were notions that recognition depends upon the reactivation of images associated with the recognized object (Hollingworth, 1913; Lehmann, 1889); the theory that recognition is a subprocess of recall (Müller, 1913); the view that recognition results from a comparison of image and percept (Wolfe, 1886; Foucault, 1911); and the quite popular idea that recognition and the accompanying "feeling of familiarity" are caused by a facilitation in underlying neural processing when perceiving a stimulus for a second time (Allin, 1895; Dearborn, 1899; Höffding, 1893).
>
> It was this last view that Semon emphatically disagreed with, and in contrast with which he developed his own theory of recognition, a *comparison theory* which relied heavily on the process of differentiating homophony.
>
> Semon distinguished two kinds of recognition. Simple recognition of a previous event is "...the manifestation of differentiating homophony between an original and a mnemic sensation..." (1923, p. 283) and does not entail conscious awareness of the difference between the original and newly perceived stimuli. To the contrary, in recognition accompanied by the "sensation of difference" the differentiating homophony gives rise to a "differential of sensation" (that is, a discrepancy between original and re-encountered stimuli that is large enough to be consciously perceived by the rememberer). Semon characterized both of these modes of recognition as products of "homophonous comparison." Consistent with his earlier position that new engrams are established by each ecphory, Semon posited that both kinds of recognition, which he viewed as subtypes of ecphory, deposit new engrams in the memory system.
>
> Semon professed no special concern with the problem of recognition, commenting that "...it is interesting to us only as the manifestation of differentiating homophony and in its capacity of a differential of sensation" (1923, p. 288). Semon did make a special effort to criticize Höffding's (1893) theory that recognition results from the "greater ease" of neural transmission of a second encounter with a stimulus relative to the first, noting that this theory was in direct opposition to his own "homophonous comparison" view. In terms of modern theories of recognition, Semon's ideas seem close in spirit to those of modern researchers who posit a continuity between recognition and recall (Lockhart, Craik, & Jacoby, 1976; Tulving & Watkins, 1973). Semon, like these theorists, drew no sharp distinctions between recognition and other forms of ecphory. However, Semon did not offer specific comparisons of recognition and

recall; hence we must be cautious in contrasting his ideas on this topic to modern theories.

Miscellaneous Phenomena

We have now presented the body of Richard Semon's theory of human memory. While there are numerous other points in Semon's work that we will not discuss, two ideas do merit at least some mention.

The first concerns Semon's analysis of "competition" between stimulus input and output from the memory store. Semon was interested in whether original and mnemic sensations are processed in the same channels or regions of sensation-fields. Semon based his discussion upon an analysis of binocular rivalry (that is, competition between two original sensations) and concluded that original and mnemic sensations do in fact compete with each other, and hence must share common mechanisms. Semon specified four consequences of such competition, but deferred their further discussion to future work:

> (1) Mnemic sensations already present lose in vividness; (2) or are extruded; (3) the ecphory of new sensations is hampered; (4) or altogether prevented according as other original or mnemic sensations are already present or simultaneously ecphorized (1923, p. 312).

Here again we find Semon concerned with a problem of little interest to his contemporaries. With the exception of Baxt's early work on masking effects (see Murray, 1976), there is little to be found in the literature of Semon's time concerning interference or competition between perceptual and mnemonic information. Several modern experimenters have investigated various aspects of this problem (e.g., Chow & Murdock, 1975; Doost & Turvey, 1971; Johnston, Griffith, & Wagstaff, 1972), but research on this topic is just getting under way.

The second idea, related to the first, is Semon's interest in serial vs parallel processing in memory. Semon noted that the sort of competition between perceptual and mnemonic information he had previously discussed exemplified *spatial* interactions. He then initiated his analysis of serial vs parallel processing by remarking that, "Instead of two simultaneous states of sensation, we are now dealing with two temporally parallel chains of sensation in competition..." (1923, p. 313). The issue of interest to Semon had to do with the question of what takes place when two engram-complexes are related equally to a particular ecphoric cue. In such cases, are the two candidate complexes retrieved in parallel, or only through "alternately ecphorizing," that is, serially processing the two complexes? In *The Mneme*, Semon concluded that in all such cases, serial processing is the rule; apparent parallel processing could be attributed to rapidly alternating ecphory. However, in *Mnemic Psychology*, Semon modified this position:

> It is not *altogether* impossible to produce side by side and simultaneously two manifestations of ecphorized verbal engrams and to let two series of such engrams run their course simultaneously side by side... side by sideness undoubtedly exists, if for a very short time, and therefore I have to abandon my first contention as to the impossibility of any simultaneous manifestation of two different chains of excitation ecphorized from verbal engrams (p. 315).

Here we find Semon clearly anticipating the issues arising from Sternberg's (1969) pacesetting work that initiated interest in serial vs parallel processing in memory. This question was simply not part of memory research in Semon's day; but for Semon, interest in serial vs parallel ecphory is just another manifestation of his theoretical concern with the process of retrieval.

Flaws in the Theory

We have now outlined Semon's theory of memory and have contrasted it with the theories of his time and with those of today.

We have been impressed by Semon's original and incisive thinking and by the remarkable degree to which his various theoretical postulates accurately forecast many problems and theories of modern memory research. However, we do not wish to imply that Semon's theory was free of problems or inconsistencies; as with any psychological theory of his time, or of the present time, Semon's analysis was incomplete in several important respects.

The most conspicuous omission from Semon's theory is any attempt to specifically deal with the problem of *forgetting*; in fact, it is extremely difficult to find the word "forgetting" in either of Semon's books. A second problem, related to the first, is that Semon did not assign a functional role to interference phenomena in his account of memory. As mentioned earlier, he did offer some discussion of "competition" and interference as regards perceptual and mnemonic information; but he did not systematically integrate this into his theory of memory. Given his lack of concern with forgetting, it is hardly surprising that interference phenomena did not play a functional role in Semon's theory.

A third conspicuous gap in Semon's analysis is his failure to specify the role of attention in memory storage. Semon did attribute some importance to attentional processes occurring at *retrieval*, as noted several times, but he never considered its possible role as a determinant of memory storage. As it stands, Semon's theory suggests that *all* perceptual events are given permanent engraphic representation; there is no mechanism for emphasizing relevant and for ignoring irrelevant information at the time of study. The role of attention in memory had been given experimental and theoretical consideration in the years preceding Semon's work (e.g., Gordon, 1903); it is difficult to understand why he did not address this issue.

A final noticeable drawback of Semon's position is that it leaves little room for active encoding processes, that is, transforming and recoding of input. Semon's remembering organism is fundamentally a passive one, incapable of changing or directing the flow of information into the memory system. His theory would have great difficulty accounting for modern research on the coding and transformation of sensory input. Of course, almost every theory of his time would have an identical problem; but this is clearly one area in which Semon's work did not anticipate modern trends.

Why is Semon's Work Unknown Today?

In the light of the points made in the previous section, it would perhaps be easiest to answer the above question by simply noting that Semon's theory was clearly imperfect, and that its subsequent obscurity befits such a flawed theory. However, such a line of argument would not take us very far, since all other theories of memory put forward in the period we have considered had at least as many gaps as Semon's theory. Indeed, comprehensive theories of memory were conspicuously absent from the literature during the time that Semon wrote; it is no exaggeration to say that Semon's theory attempted to unify and explain more phenomena and problems than almost any other theory of his time. Why, then, has such a theory, so close in spirit to many modern positions, remained virtually unknown to contemporary researchers?

We will suggest four factors that may have contributed to the obscurity which characterized Semon's theory then and has continued to this day. First, consider the heavy emphasis placed on the conditions, functions, and processes of retrieval in Semon's theory. As noted earlier, there were few studies of retrieval in Semon's time compared to the large number of studies directed at other features of human memory. More important, the few studies of retrieval were divorced from any theoretical superstructure that would have accounted for retrieval phenomena in a systematic manner. With the exception of Selz and possibly Hollingworth, systematic theoretical concern

for retrieval phenomena was rare in Semon's time. Why, then, *should* anyone have paid attention to Semon's views? Semon's problems and those of his contemporaries were very different: retrieval phenomena were of the greatest importance to Semon and of the least importance to his contemporaries. Toulmin (1961, p. 57) captured the essence of such a state of affairs in the domain of science:

> Men who accept different ideals and paradigms have really no common theoretical terms in which to discuss their problems. They will not even *have* the same problems: events which are "phenomena" in one man's eyes will be passed over by the other as "perfectly natural."

Given Semon's "aparadigmatic" stature with respect to the rest of the field, it is not surprising that his theories were never noticed and passed down to succeeding generations.

A second, and probably less important, factor contributing to Semon's obscurity is his invention of terminology. As discussed earlier, Semon created his own scientific terms in order to avoid the misleading connotations inherent in the everday language typically used to describe human memory. Others had commented on the problem (Bentley, 1899; Ebbinghaus, 1885; Hamilton, 1859), but only Semon did something about it. Unfortunately, his usage of admittedly strange terms such as "engraphy" and "ecphory," which led to potentially intimidating chapter titles such as "Ecphoric Quantivalence of Components" (1923, Chap. 11), may have served to create a barrier to the uninitiated reader. Additionally, it became easy to focus upon Semon's terminological creations rather than concentrating on the substance of his work. For instance, Campion and Smith (1934, p. 105) noted rather harshly that, "It is held by many that Semon's 'engrams' have no neurological significance and should be dismissed with others of the uncouth terms in which he enshrined his psychological tenets." Thus, in his quest for purity and precision of expression, Semon may have unwittingly contributed to the isolation of his own work.

A third and more important reason why Semon's theory of memory has not received its due acknowledgment is related to the memory-heredity issue mentioned earlier. Semon's Lamarckian views, and his thesis that the mechanisms of heredity and memory are identical, received considerable harsh criticism (e.g., Weismann, 1906). Consequently, his name became closely tied with the "wrong" views on the memory-heredity problem which lessened considerably the impact of his views on human memory in general. Numerous authors cite Semon for his ideas on heredity but nowhere mention the bulk of his theory of human memory; Brett (1921), Edgell (1924), Moore (1939), and Rignano (1926) exemplify this tendency.

A fourth factor that we propose to account for the lack of recognition of Semon's theory is that he provided no original experimental evidence to support his theory. Semon often cited the experimental literature of the time, and attempted to incorporate experimental findings into his analysis of various memory problems; he commented explicitly that "...the results of experimental psychology must be reckoned with" (1923, p. 57). However, Semon offered no original evidence other than his own introspections in support of his theory. Accordingly, one is in no way *driven* to agree with Semon or take his radical, strange-sounding notions very seriously at all.

These conjectures may or may not be valid; they are, admittedly, educated speculations. We also do not know if progress in memory research would have been accelerated had Semon's ideas been accepted in their time. But we do know that Semon's work on memory has been ignored for over half a century, and there must have been some reasons for it.

In her introduction to *Mnemic Psychology*, Vernon Lee lamented that Semon devoted so much of his time to the "hopeless" Lamarckian thesis, but expressed optimism concerning Semon's psychological theory of memory:

> The psychological part of his work remains, however highly elaborated, a fragment—a fragment, however, whose shape and substance are so suggestive that I cannot but think that a part of Semon's importance may consist in what will be added by others to the work he left unfinished (1923, p. 27).

It is perhaps sad that Semon's work never did exert the influence that Vernon Lee hoped it would. But it is ironic that modern students of memory have been concerned with so many of the issues dealt with in his theory without being aware of it. Sixty years after his death, Semon's rich theoretical constructs and novel conceptualizations not only deserve full recognition; they are also potential sources of insight to those of us who continue to be intrigued by the phenomena of memory that Richard Semon studied with such penetrating vision.

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(Received July 6, 1978)