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MNEMIC PSYCHOLOGY

Mnemic Psychology

BY

RICHARD SEMON

TRANSLATED FROM THE GERMAN BY

BELLA DUFFY

WITH AN INTRODUCTION BY

VERNON LEE

LONDON: GEORGE ALLEN & UNWIN LTD.
RUSKIN HOUSE, 40 MUSEUM STREET, W.C. 1

First published in 1923

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Printed in Great Britain by
UNWIN BROTHERS LIMITED, THE GRESHAM PRESS, LONDON AND WOKI

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INTRODUCTION

BEING NOTES ON SOME APPLICATIONS OF *MNEMIC* PRINCIPLE IN RECENT PSYCHOLOGICAL LITERATURE

BY

VERNON LEE

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I

SEMON, HERING AND BUTLER

THE *Mnemische Empfindungen*, of which Miss Bella Duffy has given us the following excellent translation, was intended by the late Dr. Richard Semon as the first of a series of applications and confirmations of the principles laid down in his *Mneme*.[1] His tragic death, and perhaps the war to whose outcome it was partly due, caused that programme to remain unexecuted. And, except a small volume of controversy on the "Transmissibility of Individual Modifications" and a posthumous fragment on the "Correlation of Cerebral and Mental Phenomena" (*Bewusstseinsvorgang und Gehirnprozess*, Wiesbaden 1920), the *Mneme* (translated by Mr. Louis Simon) and this present work are all that stands for what was intended as a kind of mnemic biology, or even of mnemic philosophy. So, as the two works are complete, each in itself, Semon having quoted from his earlier work whatever he deemed necessary in the later one, I have ventured to suppress in this English translation the sub-title "First Continuation of Mneme." Moreover, I have altered the title from "Mnemic Sensations" to "Mnemic Psychology," which seems more appropriate to its contents, and in so far more suited

[1] Richard Semon, born in Berlin 1859, was a pupil of Haeckel, and studied medicine in order to take part in a scientific expedition to Lagos. He travelled also in Australia, leaving an English account of his journey and observations, which was published by Macmillan. *Mneme* was first published in 1904, and had three editions. The *Mnemische Empfindungen* appeared in 1909. He lost his wife at Easter 1918, and, three days after Christmas of the same year, shot himself through the heart in her bedroom.

to bring it into the hands of those English readers who can profit by it most. And at the same time put it beyond the reach of certain criticisms and polemics which do not rightly apply to it, however much they may do so to the mainly biological and only incidentally psychological earlier volume, namely the *Mneme*.

For in that first book, which has, to my mind, some of the suggestiveness and charm of Darwin's works, Semon advocated the views concerning Memory and Heredity with which many of us English lay readers are familiar, thanks to the literary genius and incomparably challenging personality of Samuel Butler. Happening to be a professional physiologist and naturalist instead of a fantastic novelist turned amateur evolutionist, Semon naturally never set up Heredity as an unconscious racial Memory; still less could he dream of the mythological developments which came natural to the author of *Erewhon*. So far was Semon from any such identification of Heredity with Memory, that while the earlier physiologist by whom such an identification was started, namely Ewald Hering, had entitled his brilliant little essay "Memory considered as a Universal Function of Organic Matter," [1] Semon deliberately discarded the word and the concept *Memory* from this reference, and invented a new name and a new definition for his subject-matter, calling his first book: "*Mneme*, being the principle of conservation in the mutability of all organic happenings." [2]

So much for the difference between Semon and Butler, and Semon and Hering. What I really require to deal with is the difference between Semon's first work and the

[1] "Über das Gedächtnis als eine allgemeine Funktion der organisierten Materie, vortrag von Ewald Hering," May 1871 (translated by Samuel Butler as appendix to his "Unconscious Memory"). There have been two separate new editions of Hering's essay in the last few years; one in Leipzig, 1921, in the series of Ostwald's *Klassiker der exakten Wissenschaften*.

[2] *Die Mneme, als erhaltendes Prinzip im Wechsel des organischen Geschehens*. 3rd Edition. Leipzig, 1911. English translation by Louis Simon.

second one (of which this volume is the translation)—since upon this difference depends my wish to keep the two works (both published in English by Messrs. G. Allen & Unwin) rigorously separate; moreover also my alteration in the title of this translation of the second one. This new title of my finding is intended to emphasize that, unlike the *Mneme*, which is, as a whole, biological, the present volume is a work of pure psychology. The facts and the theories it sets forth are in no wise dependent upon Semon's contention that memory and heredity are two aspects of the same organic function. Neither, as a consequence, is the contents of *Mnemic Psychology* in the very least affected by the hostile attitude which latter-day biologists have almost unanimously taken up against any such bringing together of memory and heredity, because of the alleged inheritance of individually acquired modifications upon which such a hypothesis rests. If I may judge by the summing-up of Professor J. Arthur Thomson,[1] Mr. Carr Saunders, Mr. J. Huxley[2] and those contained in Mr. Bateson's *Problems of Genetics*, the resemblance between parents and offspring is adequately accounted for by processes in the germinal substance, and neither require, nor show any signs of, such *somatic induction* of individual responses to environment as Semon believed in; indeed, to the lay mind, genetic phenomena stand in need less of a "principle of Conservation" than of a principle of innovation wherewith to account for the minimum of variation requisite for natural selection to

[1] J. Arthur Thomson, *The Control of Life*, 1921.
Carr Saunders, *The Population Problem*, 1922.
Bateson, *Problems of Genetics*, 1916.

[2] Julian Huxley, F.R.S., reviewing the English translation of *Mneme*, and also reviewing *Initiative in Evolution* by Walter Kidd, M.D., F.R.S.E., 1922. The last-named is in favour of *transmissibility*, as are also: Prof. E. W. MacBride; "The Inheritance of Acquired Characters" in *Science Progress*, January 1921; and Prof. Eugenio Rignano, *Sulla Trasmissibilità dei Caratteri Acquisiti*, Bologna, 1907, and in *Scientific Synthesis*, London, 1910.

work upon, and for evolution to be kept going or even set up.

But whether or not future observation and analysis should eventually discard for good and all, or reinstate in part, the supposed influence on the race of individual responses to environment, these contentious questions occupy no place in the volume to which this is an introduction. It deals—and hence the title I have ventured to substitute—with *Mneme* solely as the fundamental principle of certain psychological phenomena which, whatever organic modifications they may be referred to, are primarily known to us, like all other psychic happenings, by direct self-experience. Moreover, as I shall attempt to show by a few examples in the course of this preface, Semon's *Mnemic Principle* and Semon's *Mnemic Laws* account for a good many more psychological phenomena than are usually brought under the heading of "Memory"; nay, they seem to account, quite apart from all physiological correlations, for the building-up of much of our mental nature.

Indeed, by a curious inverse coincidence this second book, designed by its writer as a mere sequel to the first one, intended as a mere application to mental phenomena of what its author regarded as a general—one might almost say as *the* general—biological principle governing all organic existence, may prove itself to be a possible starting-point for a theory of mental growth and integration of mental changes as well as of mental conservation, in short for what Mr. Kirkpatrick called a *Genetic Psychology*.

Having found this to be the case in such psychological studies as I have myself pursued since first coming across the works of my late and very deeply lamented friend, I shall, in the following little chapters, try to hand on to other students of psychology some of the many benefits, both in the way of suggestion and of orderly thinking, which I believe I have derived from Richard Semon's conception of mnemic phenomena as applied to mental happenings

II

MR. BERTRAND RUSSELL

By the greatest luck the very book wherein Mr. Bertrand Russell has introduced to the English reader as much of Semon's ideas and terminology as answered the purposes of his *Analysis of Mind*, happens to contain a couple of sentences quite invaluable as a starting-point and a final goal for what I want to say in this preface. Besides justifying my new title of *Mnemic Psychology*, they will help me to deal with aspects or results of Semon's work which did not fit into Mr. Bertrand Russell's present programme, but which have great fascination for myself and, I should imagine, also for other students. The second of these two quotations from Mr. B. Russell I shall reserve for the end of this introduction, when I intend to flash it on my reader with considerable effect. The first quotation—the one to be used as my starting-point—is the one from p. 82 of the *Analysis of Mind*. By way of a "definition of mnemic phenomena," Mr. B. Russell begins with a perhaps overincontrovertible remark, only to bring into sharper relief a somewhat mysterious but, unless I misapprehend it, extraordinarily important statement: "A definition of mnemic phenomena," he begins, "which did not include memory would of course be a bad one. The point of the definition is not that it includes memory, *but that it includes it as one of a class of phenomena which embrace all that is characteristic in the subject-matter of psychology.*"

The wording is not as clear as Mr. B. Russell has taught us to expect from him. But after some re-reading

I think I have a right, as well as a wish, to interpret the words I have italicized as meaning that the class defined as *mnemic phenomena* is the class containing not memory only but also whatever characterizes the subject-matter of psychology; which is another way of saying that psychology can be distinguished from other studies by the fact of its dealing (how much or how exclusively is another question) with *mnemic phenomena*. And this meaning is implicitly worked out by Mr. B. Russell in a large amount of the *Analysis of Mind*, to burst out with astonishing explicitness in the last chapter. Towards that final conclusion I am therefore going to wend my way, taking, as already remarked, the somewhat obscurely worded sentence I have just ventured to paraphrase as a convenient starting-point.

And what I want to say is that while Semon's ideas have evidently been of much assistance in Mr. B. Russell's *Analysis of Mind*, those same ideas of Semon's, his invention of the abstract entity *Mneme* and his whole mnemic terminology may help other readers, as much as they have helped myself, along another line of thought. Since there is possible a way of looking at *Mind* other than this of Mr. B. Russell's splendidly conducted analysis of what *Mind* already is; there is the further question: How this *Mind* has come to be the kind of thing which the analyser, say Mr. B. Russell, at present finds it to be, instead of something quite different or even something not there at all.

To this many persons would answer—Semon certainly for one, and probably Mr. Russell himself if put to it: Because the human brain and nerves, derived from the animal ditto, have evolved in a particular physical way under particular physical conditions, neither of which we yet understand, but may perhaps understand at a future period—or not. Granted. But that is not what I shall try to talk about, starting as I do from Mr. B. Russell's first definitions and working my way to his final rather amazing (though possibly quite well-founded) assertion. For it seems to me that there is conceivably

another answer to this question of mental genetics, and an answer requiring no such relegation to a problematic future nor even an ultimate appeal to physiological knowledge which is not yet forthcoming, an answer deducible from the facts, assuming them to be facts, as they appear on the psychological plane. It seems to me that we can account for the nature of the various psychical items dealt with in the *Analysis of Mind*, by reducing them (as Mr. Russell does) to *Sensations* and *Images*, and then regarding their interplay and combinations as so many *mnemic phenomena* subjected to that environmental selection which, in the psychical field, can itself be shown to act through the medium of such *mnemic phenomena*.

Now what are *mnemic phenomena*? Just before stating them to be the "characteristic" of the "subject-matter of psychology," Mr. B. Russell has given[1] us two very useful descriptions of them, viz.: "The characteristic is this: the response of an organism to a given stimulation is very often dependent on the past history of the organism and not merely upon the stimulus and the *hitherto discoverable* present state of the organism." And then (p. 78): "We will give the name of *mnemic phenomena* to those responses of an organism which so far as hitherto observed facts are concerned can only be brought under causal laws by including past occurrences in the history of the organism as part of the causes of the present response." These two descriptions, loosely negative, of what is meant by *mnemic phenomena* lead up to the positive definition of *mnemic Laws* (or rather *mnemic Principles*, in German *Sätze*) which Mr. Bertrand Russell has accepted from Semon without benefit of inventory, and translated as follows (p. 84): "Semon formulates two mnemic principles, the first or Law of Engraphy is:[2] ***All simultaneous excitements in an organism form a connected simultaneous excitement-complex which as such works engraphically,***

[1] *Analysis of Mind*, p. 75.

[2] I have italicized the translation from Semon.

i.e. leaves behind a connected engram-complex which in so far forms a whole. The second mnemic principle or Law of Ecphory is as follows: *the partial return of the energetic situation which formerly worked engraphically operates ecphorically on a simultaneous engram-complex.*

III

THE MNEMIC PRINCIPLE

"THE *partial* return"—it is this word *partial* which, to my mind, gives us the key to mental, one might have said *mnemic*, genetics, since it implies economy, vicariousness, and their joint result, the *new*.

For consider: without reviviscence of the past there could be nothing thought of as *future*; moreover, all knowledge implies experience and expectation of recurrence. But if for such a reviviscence of a past group of associated sensations there was required the return of the *whole* of the group of stimulations which had originally produced it, there could be nothing but a duplication of the already happened. The present would be swallowed up in the past and the future in both. And only the words of the Prayer-book could describe the situation: "As it was in the beginning, is now and ever shall be: world without end. Amen." To which might be added, perhaps not inappropriately: "world without mind."

Therefore, in this genetic sense at least (whatever other suggestion be superadded by Mr. B. Russell's concluding lecture) nothing could be truer than that the subject-matter of psychology is characterized by, indeed is actually dependent upon, the existence of *mnemic phenomena*. I need not illustrate this point as regards our individual mentality and its proceedings: without this particular mnemic characteristic we should all be like Bourbons, never forgetting and never learning. What does need some insisting on is that this curious *mnemic* peculiarity (I mean that a *partial* return suffices)

is what allows the transfusion of the past into the present, the capitalizing of what *has been* for the increased exploitation of *what is* and the production, the increment, of *what has not yet been.* It is this which accounts for the most elementary of all psychic happenings: the transformation of *sensations* into *perceptions.* For the sensation engendered by an original stimulation, say a peripheric stimulation, one coming from the outer world, finds in the mental organism not only a receptive response but, what is much more, a nourishing matrix of images, of *engrams,* left by previous sensations. And this living, nourishing *involucrum* of experience, of expectation and preparation, metamorphoses it into what we no longer recognize (save by analysis) as a separate sensation, not even as a group of memory-images; brings up that compact, externalised component of past, present and future to which we give the name, and attribute the existence, of a *thing.*

That is the first old commonplace of psychology. It is the most elementary result of that mnemic law of the *partial* return of an original situation sufficing to evoke far more than a partial image of the group due to that situation; of the *law,* as Semon called it, *of ecphory,* which, as already hinted, might have for a sub-title, *the law of economy,* of increase, of transformation, of mental growth and evolution.

Another psychological commonplace referable to the same principle is the genesis of *abstract* or, as Mr. Kirkpatrick and some others have better called them, *free* ideas;[1] i.e. ideas which have been cut loose from

[1] Kirkpatrick, *Genetic Psychology,* p. 133: "It is because of this fact that a creature (whose sensory-motor apparatus can be stimulated with, but also without, an external stimulation) is to a considerable extent independent of his environment, being able to act in accordance with *images of past experience instead of in respect to present stimulations.*" (Italics mine.) P. 184: "In order that consciousness may thus effectively direct behaviour it is necessary that it shall be occupied with something besides the results of present stimulation. To act effectively it must be able to represent the results of past stimulation and reaction in order that the

any particular complex of experience by repetition in various such complexes, and have therefore become applicable to different and new experiences. I will not repeat the hackneyed comparison thereof with composite photographs. Now all this is deducible from the two above-quoted *mnemic laws* as enunciated by Semon. Indeed Semon has gone much further: he has shown. . . . But before proceeding on this enumeration of results, let me point out one of the most important factors in Semon's *Mnemic Psychology*, factors doubtless not first discovered by him, but placed by him in such connection as makes them, in their turn, almost fundamental. One of these factors is implicit in Semon's constant insistence that by the *Law of Ecphory*, quoted above, not only is a memory-image no mere dull duplicate of an original sensation, but, what is far more, no two *successive* memory-images, however referable to a single (i.e. exactly duplicated) stimulation are, as a fact, I will not say *identical*, but *exactly similar*, coincident in everything. They can be only partially similar, in varying degrees; similar inasmuch as having an original common cause. But they are also different, because being consecutive, they have started from various points in their genealogical tree; because they are related not collaterally, but as a man is to his father and grandfather: evocation producing evocation and each evocation bringing (or taking away) something. There is in

end and the means of reacting to it may be selected. The more perfectly the elements of past experience may be reproduced *and freed from the connections in which they formerly occurred so as to be combined into representation of* results and of means of obtaining them," etc. (Italics mine.)

Thorndike, *Animal Intelligence* (1911), p. 263: "The use of . . . abstraction is that response may be made to some elements or aspects of a situation which have never been experienced in isolation . . . regardless of the gross and total situation in which it inheres"; p. 239: "The so-called 'higher' intellectual processes of human beings are but the secondary results of the *general function of having free* ideas and . . . this is the result of the formation of a very great number of associations . . . [and] the *loosening of the elements of an association from one another.*"

the whole business no mere, or real, repetition; still less the survival of any immortal individual image: the items are re-remembered, and there is continuity only because there is no stability.[1] And having touched upon this point, let me call attention to the profound sense of activity (in no metaphysical, possibly not even in the mechanical, meaning of the word) which Semon's work leaves in the sympathetic reader.

To begin with, his *engram*, or *engram-complex*, as he calls the mnemic residuum of a stimulation or stimulation-group, is not (despite its by no means perfectly fitting appellation) an *impression* made by something active on something passive. It is the result of a response, indeed it *is* a response,[2] whether of the bodily organism or of the mind. It is especially a readjustment, a change; and it becomes a link in a chain of change; or rather one of those multitudinous strands of change which cross and re-cross in the warp and woof of universal being, *am sausenden Webstuhl der Zeit*, as the Earth-Spirit says. For in Semon's austerely abstract and matter-of-fact books dealing with the *Mneme*, there is immanent a spirit making one think, more than of anything else, of the cosmic parts of Goethe.

[1] Semon, *Mneme*, p. 231: "The magic of repetition in the mnemic field . . . becomes intelligible once we recognize that successive stimulations produce a result essentially different in kind from the result of a single increased stimulation of a like sort. The fundamental difference is that when we repeat a stimulation we are not strengthening the already existing mnemic result, but creating a new one. The revival of this new one in its turn sets up a second mnemic excitation, etc."

[2] *Mneme*, p. 30: "unmittelbar engraphisch wirkt in keinem Falle der Reiz selbst, sondern dies tut nur die durch ihn ausgelöste Erregung."

In an interesting but excessively generalizing work which goes over much of the ground I have tried to map out roughly in the present introduction Prof. Eugenio Rignano (*Psychologie du Raisonnement*) calls the "mnemic property" a "faculté d'accumulation spécifique manquant au monde inorganique."

IV

MNEMIC CONSTRUCTION

How these webs are woven, in what manner *engram* or *engram-complex* comes to insert itself into *engram* or *engram-complex,* is the subject-matter of great part of Semon's two books. He makes one understand it, for instance, in his study of the *acoluth* (acolytic) phase of all stimulation and sensation (and similarly of all *ecphory* or evocation) in which the response to a first one is still going on when a second supervenes, the onset of the second overlapping the waning of the first, so that a portion of the one is synchronous and integrated with a portion of the other, much as in a fugue, the different voices meet one another at different points of their common phrase, uniting in new harmonies: " not a third sound, but a star." . . . (I find it difficult not to remember rather the utterances of poets than of philosophers in the presence of some of these facts.)

But to return to philosophers: Mr. B. Russell is doubtless correct in connecting this question of *acoluth* activity with what he calls (following W. James) the *immediate past,* and which was regarded by the great American as the germinal nucleus of the *real* past. Indeed, I cannot but imagine that it is to some such *acoluthic* mnemic phenomenon that we owe our sense of a *present,* which is not an abstraction but a *felt* reality: a *now* which, like our *here,* so far from being a point without parts or magnitude, is roomy enough to contain everything *felt* as present action; that is to say, sequences so coherent and co-ordinate that they belong together more intimately and consubstantially than do those merely causally

connected series we split off from them and call respectively: "Past" and "Future."

Another important item of mnemic activity, *engraphic* and *ecphoric*, has been studied by Semon under the heading of *Homophony*, meaning thereby the greater or less similarity between associated sensations and images. And this is so complicated and tiresome a detail that the reader may be tempted to shy off it as from some secondary and over-laboured point until . . . well! until he becomes aware that it is on such varying degrees of *Homophony* that depend sundry quite taken-for-granted psychological matters, like what we call *recognition* and the noting of resemblance and difference.

Connected with this subject of *mnemic homophony*, and I have no doubt, similarly boring, until its genetic importance be recognized, is the subject of *mnemic competition* (*Wettstreit*), competition resolved either as victory or compromise, and resulting in something new, in a *fusion* or a *suppression*. Nor is such mnemic competition merely for what Semon calls "fields of sensation," [1] whereby Present and Past compete, and variously make room for one another. For the Present means constantly new stimulations and sensations, new attitudes and actions, the Present whose mark (how express it?) is that *it goes on*, whereas the Past only *remains*, and

[1] Henry Head, M.D., F.R.S., *Studies in Neurology*, Appendix, p. 831: "We believe that the physical forces of the external universe produce within us a number of impressions which are in many cases incompatible with one another from the sensory point of view. These are sorted, combined and controlled within the central nervous system until they are sufficiently integrated to underlie sensation; the final product is simpler than its constituent elements."—On p. 808, Dr. Head has said that "Many of the impressions produced by a single external stimulus are incompatible with one another, and some of them must give way in the conflict. But the result of the struggle . . . may be reversed by *some previous occurrence which has changed the disposition of the central nervous system. The form assumed by a reflex may be determined by the character of the moment which preceded it and the phenomena of sensory adaptations depend upon the active influences of the past . . .*" (Italics mine.)

unless it be gathered up into the present and there revived, shrinks and disappears. There is in Semon a simile which seems to signify that such a primary competition was clear in his mind, although his austerity as a psychologist may have regarded it as metaphysical. Explaining the seeming eccentricities of what is called *Association of Ideas*, Semon compares what is remembered to islands which seem disconnected until, plumbing the surrounding depths, we discover that they are only the summits of chains of mountains, whose roots and flanks are hidden by the separating waters. I think those mountain-chains are our past. And what makes their peaks seem mysteriously isolated, is surely our present: the ceaseless streams of new stimulation and new sensation submerging more and more of that lapsed past. There is thus—and perhaps this is at the bottom of all Mneme, a competition between what has been and what *is* and continues; there is the victory of the present, which accepts from the past only as much as it can integrate with its substance and turn to its uses.

In this manner some of the most taken-for-granted details, one might almost say "categories," of our mental life come to be—not *analysed down into*, for Semon is not, like Mr. Russell, an analyser—but rather *built up out of* mnemic phenomena, *engraphy* and *ecphory* and their sub-categories. Or perhaps I should say that, as we fix our attention upon these elementary mnemic phenomena, thus accurately sorted, sifted, labelled and catalogued by Semon, we become gradually aware that they are grouping together into familiar psychical groups; and that these groups are coalescing into what we mean when we speak of our *Mind*.

V

MNEMIC PSYCHOLOGY

AFTER the publication of the book to which this is an introduction, Doctor Semon's work, as exemplified in the fragment *Bewusstseinsvorgang und Gehirnprozess*, published posthumously in 1920, became specially concerned with the correlation of psychical and physiological processes. But even more (in *Der Stand der Frage nach Vererbung erworbener Eigenschaften*, 1911) with evidence and arguments in favour of the thesis which he had taken over from Hering and shared with Samuel Butler, to the effect that *Mneme* (or as they had called it *Memory*) was a property of all living matter, and that mnemic phenomena could therefore account for bodily inheritance and for phylogenetic similarities, as much as for memory in the literal acceptation of the word, and for the psychical processes built up by *engraphy* and *ecphory*, and their subordinate categories. And in view of the present attitude of biologists towards the alleged transmission of individually acquired modifications, I cannot but regret the time which my friend bestowed upon this subject. Or, rather, regret the time which this nowadays apparently hopeless thesis took away from a continued examination of the purely psychological aspects of *mneme* to which he often alluded as *mnemic pathology*. For time, which he spent with the unstintingness of his singularly accurate and minute modes of thought, was refused him and his work. Not merely because Richard Semon's life was cut short by his own hand at the age of fifty-nine, but even more because a series of calamities—the long, hopeless illness of his wife, the solitude in which he was left by her death,

and the despair of witnessing his country's downfall—would seem to have sapped his intellectual vitality before their united strain drove him to suicide. Though whether, had he found strength to live, he would ever have recovered his interest in work seems to me doubtful in the present plight both of Germany and of German science. Be this as it may, 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 has left unfinished. His ideas seem to go far beyond his own writings, especially in the field of what Mr. Kirkpatrick calls genetic psychology. And already his ideas seem to put a connection through the facts and hypotheses brought forward by others. I shall therefore attempt, in however sketchy and amateurish a fashion, to point out and unite together some applications of mnemic principles which seem implicit but disconnected in the works of some other recent psychologists.

VI

RIBOT AND "MÉMOIRE AFFECTIVE"

AND first and foremost, the work of a great pioneer in psychological thought who, as may happen with pioneers, yet failed to recognise that Semon was prospecting and mapping out the same dark regions he himself helped to open up. I am speaking, with immense admiration and very personal gratitude, of the late M. Th. Ribot. More especially, however, of two cognate though separate, and, I think, very last studies of his, namely that dealing with *Mémoire Affective*, which appeared in the *Revue Philosophique* for 1907; and another, which appeared there in 1912 (vol. I, p. 248) under the extraordinarily suggestive title of "Le Rôle latent des Images Motrices." [1]

Although the notion was familiar to the man-in-the-street, the assertion that our emotional states can leave memory-images distinct from, and independent of, the remembrance of the persons, places, and circumstances associated at the time with such emotional states, the allegation, that "affective memory" is a substantive psychological phenomenon, was met with a deal of incredulity and opposition. *A priori* reasons of course abounded; and there was a good deal of flat denial on the score of personal experience, or rather the lack thereof. On the part of psychologists there was a tendency to

[1] I am told these essays form part of a little posthumous volume published by Alcan in 1919 under the name of "La Vie inconsciente et les mouvements." It is at present out of print, and I have not been able to procure it. The same subjects had been touched upon, but with far less boldness, in Ribot's earlier volumes, *Psychologie des Sentiments* and *Logique des Sentiments*.

insist[1] that what Ribot took for the memory-image, for the mnemic reviviscence, of past emotion, was in reality merely a present, a new, emotion stimulated by the reviviscence (which of course no one could dispute) of the memory-images, visual, auditory, tactile and quite especially olfactive, left by places, persons and general circumstances which had originally been associated with the emotion under consideration. Since while nothing was easier than to compare the memory-image due to one of the peripheral senses with the correlate sensations obtainable from the outer world, it seemed impossible to experiment similarly with the memory-images alleged to have been left by such past organic and cerebral changes as are nowadays connected by psychologists with what is called an *emotion*. Nor could anyone assert that he was able to revive (as distinguished from merely *describing*) his own past emotions *without* also remembering something of the *when*, *where* and *why* of these past emotions. Appeal to literary testimony was useless, for literature deals largely with sights and circumstances, and with symptoms accompanying emotion; let alone its usually giving reasons why the emotion described, real or imaginary, originally took place at all. Nevertheless, M. Ribot had found the proof that emotions *do* leave memory-images. He had found a field in which such emotional memories (emotional *engrams*) were revealed entirely divorced from associations of places, persons and the rest of the world; indeed, dissociated from every kind of similarity or analogy except that furnished by the equally obscure field of motor sensations and their auditory representatives. Music, in fact, owes its curious power of awakening various and specific kinds and degrees of emotion to the fact that its changing, and progressing patterns of sound draw (by the mediation of human movements) upon what Semon would have called a store of *engram-complexes*, left behind by affective experience.

Nay more: these emotional memories, by dint of that similar-dissimilar recurrence (Semon's *Homophony*) to

[1] E.g. Messer, in *Empfinden und Denken.*

which all abstract ideas have long been referred, these emotional *engram-complexes* stirred up by music, have become so abstract, so schematic, so utterly despoiled of all their original concomitants as to coalesce, for the hearer's imagination, and become identified with the musical pattern of notes, turning into the *expression* inherent to that music, as one of its well-known effects and intrinsic qualities.

Thus music's legendary sway over the passions came to be the proof that emotional states can and do leave mnemic images, *free ideas* of emotion, as reviviscible in all manner of conjunctions as any other kind of schematic abstraction.

But if, thanks to Ribot, we recognize in this phenomenon of musical expressiveness the presence of affective memory-images, shall we not look for their existence elsewhere, also in more familiar, though less enquired into, matters ? The study of individual responsiveness to the emotional appeal to music, undertaken by me to test M. Ribot's hypothesis, has led me to suspect that a good deal of our response not to musical expression but to the real feelings of our fellow human beings is susceptible of the same explanation. I mean that what we call *sympathy with others* must be due largely to mnemic storage and evocation of our own affective experience. It seems a truism to say that those " who have been there " are more likely to have a fellow feeling, whether the THERE be *in* love or *in* fear, or any other emotional state. And such is surely the meaning of Macduff's answer, " he has no children," whether we refer it to the barbarity of Macbeth or to the would-be consolations of young Malcolm. Sympathy is usually explained as arising from the recognition either of another person's facial expression and gesture, or of the import of his words and situation ; but (unless we beg the question by invoking a natural instinct !) I cannot see why such recognition should not, instead of causing an emotion, remain purely intellectual, unless it evoked a reviviscence of something we had ourselves experienced. The faintness and fluctuation of such sympathetic feeling, compared with the intensity and

insistence of our own immediate emotions, is precisely paralleled by the faintness and fluctuation of visual and auditory memory-images (which would otherwise become hallucinations) when compared with their correlated sensations. This seems to be a case of the already mentioned competition between present and past: the present, represented by our actually existing circumstances and mood, allowing the defeated past, i.e. the emotions previously experienced by ourselves but now attributed to our neighbours, to live only a disembodied, a ghostlike kind of life. Just as we see a real chair or table THROUGH, I mean despite of, the mental image of an absent visitor, so also, when not called on to take action or at least to put into words, we can usually perceive our own really existing mood THROUGH the sympathetic feelings evoked by the circumstances of other folk.[1] Moreover, many of us can be clearly aware of the contemplative and abstract character of much of our sympathy, just as we are, so

[1] Lloyd Morgan, *Habit and Experience*, p. 113: "When once it (emotional tone) has been acquired, when once associated connections have been established the emotional meaning . . . may be called up or revived within a cortical disposition before visceral impulses again come to supplement the emotional experience in primary fashion. I take it, however, that in the absence of such re-enforcement an emotion is so coldblooded as to be scarcely worthy of the name."

Cf. R. d'Allonne's "Rôle des Sensations Internes" (Clinical Observations), *Rev. Philosoph.*, 1905: "L'anesthésie interne a laissé (in his patient) subsister . . . quelque chose qui n'est plus une émotion mais un résidu d'éléments cognitifs d'où est absent . . . le *vibrement*. Ce résidu . . . continue à se systematiser et suffit à engendrer bien des actes."

In a French article, "La Mémoire affective et l'Art" in *Revue Philosophique* for 1909, Professor Mark Baldwin writes: "J'adhère en principe aux idées de M. Ribot telles que je les comprends. C'est à dire que je crois qu'une émotion est en elle-même susceptible de reparaître et d'être reconnue." And adds, not very clearly: "Si nous admettons que toute généralisation . . . est la réduction d'expériences analogues à des espèces par *l'union ou la synergie des éléments moteurs* qui leur sont communs . . . de tous les états psychiques l'émotion est celle qui se trouve qualitativement le plus influencée par les éléments associés."

to speak, only *schematically* aware that a piece of music has a specified emotional character.

It is surely of such stores of schematic emotion that Virgil's *Sunt Lachrymæ Rerum* is a confused poetic recognition: emotions which "touch our minds" (*mentem mortalia tangunt*) without necessarily altering our condition or influencing our actions. And it was by an odd puritanical misapprehension of the particular nature of such emotion that W. James advised those who had been deeply touched by a piece of music to be kind to an aunt or give up their seat in a tramcar.

A systematic investigation of the quality, the concomitants and the occasions, of sympathy for our fellow-creatures would surely be worth undertaking by some of our younger psychologists. It might put an end to a good deal of vague talk about such matters as "herd instinct," indeed about instincts in general, and of those convenient but unintelligible entities, the various "organized tendencies" which have succeeded to the status of the "innate ideas" of earlier psychology.

And if, as I venture to foretell, such an investigation resulted in showing that human sympathy was genetically allied to our emotional responsiveness to music, why, then, *mnemic phenomena* might become part of the "subject-matter" to quote Mr. Russell, of social, as well of other branches of psychology.

VII

RIBOT'S "IMAGES MOTRICES"

I MUST, however, return for a while to those other branches of psychology, those concerned not with the emotions, but with what Mr. B. Russell has analysed under the name of *mind*. And, in order to show some further illustrations of the omnipotence of the mnemic principle, return also to the late M. Th. Ribot. Since, in the very last years of his life, he hurried on from his study of *Mémoire affective* to that, which he had barely time to sketch out, of a cognate set of mnemic phenomena, best summed up by the title of his essay "Le Rôle latent des Images motrices."

And dealing once more with *mind*, I shall let myself be guided once more by Mr. B. Russell's *Analysis*. He is careful to point out that, besides our awareness of the qualities, present or prospective, of an object, we can detect in ourselves something which does not constitute one of that object's qualities, namely, a sense that the object in question *exists*. We can even, he adds, recognize on our own part a rather respectful acquiescence to the object and its qualities existing independently of our views; or, in common parlance, a sense that the object is *real* and not *imaginary*, and its existence is *present* and not *past*. As Mr. Russell, like Semon, regards *sensations* and *memory-images* as ingredients sufficient to account for the nature and proceedings of our mind, he would, if put to it, be ready to analyse down such a *sense of reality* or *state of belief*, into combinations of sensations and memory-images. These, however, could

evidently not be the same sensations and images which, taken together, constituted our notion of the object about which we experience the *sense of reality* or *state of belief*. They would be other sensations and images previously grouped together, and (I think Mr. Russell would admit) they would be not only such as were originally derived from the peripheral sense connecting us with the outer world but also, perhaps mainly, such as were derived from the internal adaptations, roughly classified as *muscular* or *kinæsthetic*, wherewith our inner world (what the witty biologist Le Dantec conveniently called our SAC DE CUIR) responds to the stimulations of which eye and ear, skin or nostril, are the transmitting agencies. Recent empirical psychology, especially German and American (Ribot refers particularly to Marbe, Ach, Messer, Titchener, and Judd), has devoted considerable attention to these psychological items, which, in order to separate them from the *sensations* and *images*, or rather the *perceptions*, to which they refer, I venture to call, for lack of a better name, "senses THAT . . .," e.g. "a sense THAT so-and-so IS, etc.," or "a sense *that* so-and-so *is not*, etc.," let alone *the sense that so-and-so is in the present* (or in the past), THAT *so-and-so is similar* (or dissimilar), familiar (or unfamiliar, etc., etc.); all these are psychic adjuncts to the sensations and images round which they gather, and, by the way, Semon has made important suggestions about them in his sections on *Mnemic Homophony* and *Mnemic Competition*. Be this as it may, these particular psychological items have received much, though not *overmuch*, attention under the name of *attitudes*, *mental sets*, or, in German, *Akte*, *Einstellungen* and *Bewusstseinlagen*. They are obviously of the nature of responses, though not responses (like *sensations*) to single stimulations; responses rather to whole situations. And they often form an integral, though usually unnoticed, part in those combinations of present sensations with past images which are called *perceptions of objects*, and expressed in the words "so-and-so IS," etc., etc., or "so-and-so denotes," etc., etc.,

or " so-and-so *will, cæteris paribus, become* or *do,*" etc., etc., etc.

I do not know exactly how much suggestion M. Ribot may have received in this matter from younger predecessors; but his genius for synthesis seized upon their recognition that these hitherto imperfectly classified psychological items could be referred to *attitudes of our own,* to responses *on our part* such as are already incipient actions. After his dealings with emotional memory, it was for him inevitable to connect these *attitudes* (or " senses that ") with sensations from those parts of the body and brain which execute and control our movements and positions in space. And having done this, more inevitable still to identify them as the memory-images, IMAGES MOTRICES, which motor sensations, like all other sensations, must leave behind them. And, finally, Ribot boldly claimed for these motor images that they constituted, actually or latently, the skeleton of our thinking, the schematic framework upon which sensations (and images) coming from the outer world, and doubtless also from the *inner* world of our *sac de cuir,* took their appointed place, their shape, and their *significance.*

Their Significance—M. Ribot would, I believe, have added that word had he been able to expand that hurried essay into a book. It happened, however, that at the moment of his writing it, he had plunged into the controversy concerning the nature of the " unconscious "; and having already thrown his " mémoire affective " into that mysterious and rather unprofitable whirlpool, he hastened to do the same by his " Images Motrices." Instead, therefore, of examining more thoroughly into their nature and into the evidence for them, he proceeded to the hypothesis (of which more anon) that motor images had, somehow, a more permanent, though more hidden, existence than the other kinds of images, and, if I may be allowed so prosaic an expression, made themselves generally useful in stimulating the (otherwise tardy ?) reviviscence of the less tough and less closely articulated

(he evidently visualized it all as a *skeleton*) memory-images derived from our intermittent dealings with the outer world through the peripheral senses, like touch, sight, or hearing. Whether or not this view of Ribot's concerning the "" unconscious" should prove eventually acceptable, I am not fitted to judge. What I think likely is that its pursuit (in a second article, especially) prevented Ribot from grasping certain further details concerning his *Images Motrices*, although they lay ready under his very hand. And believing, as I do, that these developments of his subject would sooner or later have occurred to that wonderful old man, I venture to mention some of them which have resulted from the special studies in which M. Ribot gave me his help and encouragement; for they seem to belong to his suggestive genius quite as much as to my own—whatever their value—observations and experiments. The latter have dealt with the phenomena of æsthetic responsiveness, especially those which my friend Professor Karl Groos had called "Innere Nachahmung," and Lipps, discarding the notion of mimicry, more correctly "æsthetische *Einfühlung*" (æsthetic *Empathy*). This *æsthetic Empathy*, which I have dealt with elsewhere in extreme detail,[1] can be summed up as our attribution of motion to visible shapes belonging to motionless objects, such as architectural details, all kinds of patterns, and even details of natural scenery, quite as much as to figures representing living creatures; the attribution by us of modes of activity, even actual movements, such as we are familiar with in ourselves, but have no other reason for associating with the shapes we are looking at. The standard examples of this curious psychological process, this projection of our own *motor* experience, are Lipps's now famous *column which rises*, although we are thoroughly aware that the stone drums whereof it consists are, on the contrary, pressing down upon one another; and also the mountain of classic poets which rises (or rears its head) into the sky, although we know perfectly well

[1] *Beauty and Ugliness*, John Lane, 1912. Also "The Beautiful," *Cambridge Manual*, 1913.

that it is really diminishing in height and slipping down by the very process of erosion, to which that rising or rearing shape is due. Just as M. Ribot had found in the expressiveness of music the proof that *emotional memory* must exist, just so, it seems to me, that in this equally gratuitous phenomenon of *æsthetic empathy*, of this attribution to the lines and curves we behold of such modes of our own activity as, e.g. ease, effort, swiftness, gentleness, jerkiness, etc., etc., we can recognise Ribot's *Images Motrices* in an equally abstract, schematic, and, so to speak, entirely disembodied condition.

But æsthetics, alas, are the most God-forsaken little corner of mental science, avoided equally by psychologists who have no æsthetic perceptions and by art critics who have no psychological education; and if such schematic *Images Motrices* were confined to it they would doubtless be huddled away under that ample "Play Instinct," which is sufficient explanation of all æsthetic phenomena. But having recognised such *Images Motrices* in my dealings with visible shapes, I have pursued them to another and very differently important field, where their existence, though apparently unsuspected, cannot be so easily pooh-poohed. Since *Language* not only employs all manner of motor images, it actually calls them by the names derived from movement in space, even when they refer to movements (the word *movement* almost suffices to prove the case!) of THOUGHT. Besides the words denoting things and their qualities, language makes an equal use of others which cannot, like nouns and adjectives, be referred to sensations of peripheral origin: words which have, so to speak, no contents or interest of their own, but which mark the relations of those things and qualities denoted by nouns and adjectives, relations to one another and to ourselves, relations in time and in space; furthermore, relations causal and valuating (also words denoting our acts of taking stock, comparing and measuring, like *before, after, within, without, between, above, below*; and words expressing our acts of joining, separating, integrating, our very gestures of

pausing, pointing out, or emphasizing, or slurring in the process of perceiving and thinking: *and, but, for, since, therefore, notwithstanding, nevertheless.* And besides these prepositions and conjunctions there are the tenses of verbs, by whose correlation we express, not, indeed, the (often visible or tangible) nature of an action, which is given in the infinitive or root of a verb, but the relation of various actions towards each other, their succession or simultaneity, their overlapping and conditioning of one another, everything which a writer conveys by the concordance of the various forms of past, and concordance between past, present, and future: these apparently empty words express our attitudes, our acquiescence, or inhibition, the very fact that there is preparation for expected change.

I am duly intimidated by Mr. B. Russell's warning that all languages (he knows Chinese!) are not necessarily like those we happen to know, and some languages are, doubtless, like nothing we can possibly imagine. I will, therefore, pending the verdict of some friendly comparative philologist, restrict my statement, and say that in the few—the very few, alas!—languages I do happen to know there exist such words as I have just described, employed as described;[1] and that (as a result of some analyses within the range of those languages) they appear to answer pretty exactly to M. Ribot's "canvas," upon

[1] *Rôle Latent de Images Motrices*, p. 249, footnote: "ils [movements] forment la trame sur laquelle la conscience dessine ses broderies." Same page, speaking of the "irradiation de mouvements qui s'étend à toute notre vie physique," he adds, "dans la vie intellectuelle elle n'est pas moindre."

Messer, *Empfindung und Denken*, p. 77, "reproduzieren können wir Akte, aber dabei ist nicht gesagt dass sie bei ihrem ernennten Vorkommen eine derartige Verschiedenheit zeigen wie sie bei der Reproduktion von Empfindungen allgemein anerkannt ist . . ." (and adds) that he is "geneigt das Vorkommen einer sekundären Form [memory-image?] der Akte in abrede zu stellen."

On the other hand, Dr. G. Saint-Paul, *Langage Intérieur* p. 12, says unhesitatingly "la région dite motrice renferme non seulement des centres moteurs . . . mais encore des centres qui ne sont pas incito-moteurs *mais bien de pure mémoire motrice.*" (Italics mine.)

which our thoughts-about-things embroider their patterns; and to his more frequent and perhaps better simile of a skeleton of "Images Motrices," upon which the more unstable tissues of perceptions and *their* memory-images are held in place and articulated.[1] In fact, they seem to me to constitute all the relational and *modal* portions of discourse; and if our thinking is expressed or influenced by speech, indeed, I venture to add, even on the occasions when this is not obviously the case, these prepositions, adverbs, conjunctions, and verbal tenses are the symbols of the motor-images and schemata, the free *ideas* of motor-origin, necessary for our relational and logical thinking. Motor memory-IMAGES, I venture to insist (against Messer and sundry others), and not motor *sensations*, since only mnemic repetitions with its economy of stimulation and its alterations in homophony, could reduce them to this degree of abstraction and leave them free to enter, as schemata, into new combinations. If, as my master Ribot asserted, this is the "hidden *rôle* of motor images," then it is to mnenic phenomena we owe not the contents of our minds only, but our mind's dealings therewith. And it is the "Mnemic Laws" of Semon, and his illustrations of those laws' action and reaction, which render this intelligible.

[1] Cf. My recent book, *The Handling of Words*, John Lane.

VIII

MNEMIC HEDONISM (KIRKPATRICK AND THORNDIKE)

I HAVE dealt hitherto with what seem to be illustrations and applications of mnemic psychology in the work of a psychologist, namely Ribot, who failed to grasp the importance of Semon's system. I now pass to more such illustrations and applications on the part of other psychologists, who, for aught I know, had never so much as heard of it. I am not alluding to Mr. MacDougall's explanations of everything by inherited (Semon would have said *mnemic*) instincts, which operate in such manner as to preserve the species while, at the same time, knocking on the head that "" Hedonistic " fallacy which is so offensive to latter-day moralists. The psychologists I am speaking of are, on the contrary, those, especially Lloyd Morgan, Kirkpatrick, and Thorndike,[1] who recognize in the pleasure-displeasure alternative a kind of subordinate, an individual, selective factor, without which " Natural Selection " might find much less either to foster or to eliminate: a more economical substitute, as Kirkpatrick puts it, for death.

[1] Kirkpatrick, *Genetic Psychology*, p. 352: " Pain thus serves as a substitute for death. It is a more economical means of evolution in the species than death and favours variety of action in the individual. The negative action . . . is supplemented by the positive influence of pleasure."

Similarly, Thorndike, *Animal Intelligence*, p. 121: " For a lot of the similarities which are non-essential have to be stamped out, not by a power of *feeling likeness but by their failure to lead to pleasure*." (Italics mine.)

P. 204: " The function of intellect is to provide means of modifying our reactions . . . so that we may secure pleasure, the symptom of welfare."

Now this *more economical* kind of selection which I should like to call *selection by preference*, cannot be operative, and still less be genetically efficacious, if it is only selection by PRESENT pleasure or displeasure. It must be selection in accordance with the MEMORY of pleasure or displeasure, experienced in the past and anticipated in the future (Kirkpatrick's "anticipatory images"). It is true that Mr. Thorndike, just one of the writers who make most use of the notion of selection by the pleasure-displeasure alternative, has a rather obscure pronouncement that "there is no pleasure along with the association. The pleasure does not come until after the association is done and gone." And adds, or rather forestalls, on page 147, asking: "How are the pleasure-results able to burn in and render predominant the association which led to them? This is perhaps the greatest problem of both human and animal psychology." Not, however, if what is associated instead of the actual pleasure in the present is only the pleasure (or pain) in the past, that is to say, the *mnemic* correlate, the image or the *engram*, left by such pleasure (or pain) on a previous occasion. And Dr. Head's recent discoveries[1] surely entitle us to believe that pleasure and displeasure are quite able to leave in memory traces capable of reviviscence. But even supposing this inference of mine from Dr. Head's discoveries to be mistaken, and pleasure and pain, AS SUCH, to leave no mnemic images, there would be left behind the images of all the other sensations referable to the attitude and the reactions to those in themselves mnemically sterile, pleasurable or painful states.[2] Whether the engram-

[1] Henry Head, M.D., F.R.S., *Studies in Neurology*. 2 vols., 1920.

[2] Kirkpatrick, *Genetic Psychology*, p. 237: "In general, the changes in acquired perception are in the reaction and attitude towards the situation as a whole."

Also, p. 234: "In perception not simply a feeling of agreeableness or disagreeableness, but a mental attitude towards the situation or object suggested . . . which may install anticipatory images . . . and in man in a certain stage of development may arouse memory by the positive influence of pleasure. . . . All the modifications in behaviour (which bring relief and pleasure) are likely to be repeated."

complex resulting in the burnt child's avoidance of fire contain memory-images of pleasure or pain *as such*, or only memory-images of the child's yells and writhings when it got burnt, it is evident that directly or indirectly that child's memory of an intolerable adventure is what prevents it from getting burnt a second time. "I cannot remember what it was made me dislike her so much," said that emotionally tenacious old friend of ours; "but I *do* remember that I couldn't bear the sight of the creature ever since. And that is enough for me."

Enough also to have given rise, for even the most oblivious men and women, to a scale of mnemic preferences and aversions quite sufficient to act as a selective factor, and help out that other more cumbrous and wasteful selective factor called Death. Sufficient also—and that is what I am desirous of insisting on—to build up our lives by building up our habits, our inhibitions, expectations and judgments, through the ceaseless attractive or deterrent influence of past pleasure or displeasure, in accordance with the Mnemic Law economizing the new experience by the merely partial recurrence of the situation which had constituted a previous such experience. Had it been otherwise the burnt child would have gone on getting burnt, or its equally oblivious and much-singed offspring would eventually have been burnt to death, and the human race, at least such as lit fires, come to an end: selection by death would have stepped in to replace, to no good purpose, that deficient selection by the memory of pain.

IX

MNEME AND CONSCIOUSNESS

AND now the time has come for that second, and perhaps startling, quotation from Mr. B. Russell's *Analysis of Mind*, towards which I have been working my way (though agreeing completely with neither) from his first description of the mnemic element as characteristic "*of the subject-matter of psychology.*" In the very last chapter of that admirable book of his, he makes the following statement: "Sensation itself is not an instance of consciousness, though the immediate memory by which it is apt to be succeeded is so. A sensation which is remembered becomes an object of consciousness as soon as it begins to be remembered, which will normally be almost immediately after its occurrence, if at all, but while it exists it is not an object of consciousness."

This assertion is unnecessarily startling, because Mr. B. Russell has not thought fit to support it by either evidence or arguments, but hurled it (perhaps not without his malicious little smile) at the head of a reader who may not be as profoundly versed in mental science as himself, or even as I. For although only an æsthetician, I happen to have known that notion of a *mirroring function* ("fonction miroir") ever since 1904 or thereabouts, when it was formulated in the wonderfully interesting volume *Le Langage Intérieur et les Paraphasies*, by a French hospital doctor called G. Saint-Paul;[1]

[1] Dr. G. Saint-Paul, *Le Langage Intérieur*, p. 16: "Le territoire psychique reçoit donc en quelque sorte le *reflet* (italics) de sa propre activité, grâce aux territoires infra-psychiques qui font

although it is probably to be found elsewhere, more especially, I imagine, in the works of clinical psychologists. I am, of course, quite incompetent to judge whether or not it will hold water. Indeed, one of my reasons—the only one I am sure about—for not accepting this notion as given by Mr. B. Russell, is my rooted prejudice against talking of something which does not reach consciousness as a *sensation*, when it can only be a *sensory stimulation* whose existence we infer because we are conscious of something which we are told *is not itself a sensation but only the memory-image left by* . . . well, by what I refuse to call *sensation* on precisely that account. It is difficult to be clear, even in criticizing so confused a mode of expression, common, alas, among philosophers though avoided by Dr. Saint-Paul, like Dr. Head, and I imagine other physiologists and clinicians. In the case, however, of Mr. B. Russell, that least confused of all analysers of confused happenings, the paradox of a *sensation* which becomes conscious only when it has been replaced by its own memory-image, is, I take it, the logical outcome of his previous statement which, by calling *mnemic phenomena* " characteristic of the subject-matter of psychology," turns *mnemic* into equivalent to *psychological*, which, in connection especially with an *analysis of mind*, is pretty nearly equivalent to what we know as *mental*, which itself is pretty nearly the same as " directly *given to* (or *in* or with whatever preposition you prefer !) consciousness." Now, having undertaken to write this preface with the express object of pointing out the importance to psychology of what Semon called *mneme*, I ought very likely to pass over my repugnance to *unconscious sensations*, and be only too pleased and proud that consciousness should put off its appearance until the previous arrival of *mnemic phenomena*, since that is what the second quotation from Mr. B. Russell comes to.

office de *miroir*. Les actes psychiques peuvent donc se percevoir euxmêmes, mais seulement par le contrecoup qu'ils déterminent dans d'autres territoires nerveux."

Perhaps I should do so, and even fall to talking of unconscious sensations, when I meant unconscious sensory *stimulation*, if it were not that there is another hypothetical function which might, perhaps with more reason, be put to the credit of *mneme*.

For, apart from thus knowing that, as he says, there *are* sensations which become conscious only after they have been replaced by the recollection thereof, how does Mr. B. Russell know that there may not be mnemic phenomena elsewhere than in the "subject-matter of psychology" which, on page 82, he had assured us they "characterize"; in short, that *mnemic phenomena are* [not] *just as much to be found in physiology as in psychology*? Mr. Bertrand Russell knows the exact reverse, since the above sentence which I have italicized is his own, occurring on page 90; and the only "not knowing" in the matter is my own dull failure to grasp how he reconciles his two seemingly conflicting statements. Of course I feel sure that he *does* reconcile them; indeed my "how does he know that?" etc., is merely a convenient rhetorical dodge wherewith Mr. Russell has helped me to push on in my account of other people's views of the possible relations of Mneme to Consciousness.

Of course Hering and Semon, like Butler, were so far from regarding mnemic phenomena as *characteristically* psychological, that they claimed *mneme* as a property of all living matter. And even if they were mistaken in applying it to explain heredity, is there not evidence of something similar in the phenomena of habitual reflexes, of growth and regeneration, above all in the phenomena of what was called in my youth "unconscious cerebration" (and a very good name, surely!)? In short —and here I come to Mneme's other possible function— is there not a chance of *mnemic phenomena* proving equally characteristic of, indeed constituting the very essence of . . . well, *not consciousness*, but the *un*conscious?

That was the contention of the late M. Ribot, and

doubtless not of M. Ribot alone.[1] He, indeed, had an eye to his own favourite motor memory, his "Images Motrices," and their "Rôle Latent." Such motor memory-images are undoubtedly more difficult to run to ground than the images corresponding to sensations from the peripheral senses, eye, skin, etc.; so much so that except in the condition of such verbal and æsthetic schemata as I have alluded to, it is difficult to find examples of them except joined to peripheral sensations and images. Like the motor sensations whence they are derived, they constitute part of our massive bodily response to such peripheral sensations and images; they are, in contradistinction to the latter, eminently part of *ourselves*. And except we happen to be psychologists, our egoism tends to mask the ego behind the things and the qualities of things by which that ego is attracted or repelled. Anyhow, we are rarely, if ever, aware of motor images taken by themselves; and this alone may seem sufficient reason for identifying them with the *Unconscious*, more especially if we consider that our visceral processes, and even our neural and cerebral ones *taken as such*, are similarly normally hidden from direct knowledge as distinguished from inference; so that the two classes of images (and for that matter also sensations) motor and visceral, may be said to be *unconscious* if we employ that word like Ribot (and Semon) as equivalent to *physiological*. Now, putting aside all problems of hereditary transfer, it seems likely that the *physiological* is, if I may so express myself, a network of habits and tendencies; and that repetition and

[1] See a curious passage in Messer's *Empfindung und Denken*, p. 82. Of course Bergson proclaimed that the kind of memory "qui se joue" is bodily. But as he assured us that the other kind of memory "qui imagine" is entirely spiritual, his views on this subject seem subordinated to his metaphysical reinstatement of free will and, despite his wonderful psychological talent, are really neither here nor there. By the way Bergson does not use "image" in the sense of Mr. Russell and of these pages. On the contrary he avowedly employs "image" as equivalent to "chose" while protesting against "idealism."

recapitulation are more at home in our " Sac de Cuir " than in that realm of " Consciousness " which is so much more at the mercy of the outer world. This would surely justify the supposition that if *mnemic* laws govern the *mind*, they hold good no less for the body, including in the body our brain and nerves ; [1] and that there may be mnemic continuity and mnemic causation in the body as much as in the mind. Perhaps indeed *between* (if one can use such words) the " Body " and the " Mind " ; *between* Consciousness and the *Physiological* Unconscious ; which, by the way, would account for one of Consciousness's most freakish peculiarities, namely, its extraordinary intermittence, its absenteeism and alibis. Without intruding upon the various Freudian Limbos of *sub-*, *fore-* or *co-*consciousness or even taking into account the " unconscious " feats of poets, thinkers and mediums, there is the daily or nightly occurrence by which our consciousness finds itself in possession of

[1] G. Saint-Paul, *Le Langage Intérieur*, p. 16 : ". . . inconsciente . . . comme l'est la . . . mémoire des cellules du territoire psychique car nous pensons *ces cellules douées de mémoire comme toutes les cellules de l'organisme.* (Italics mine.)

Cf. H. Head, *Studies in Neurology* : " All projected sensations leave behind them certain physiological dispositions ; for instance, the existence of the schemata ensure that a movement occurring at one moment, is measured against the consequences of those which have preceded it. *This is not a psychical act, but occurs on the physiological level. . . .*" (Italics mine.) Also p. 747 *et seq.* : " The nature of the anteceding *reflexes* [Italics mine.] is of fundamental importance in determining the form of the reaction to stimuli of the same quality and strength. . . . On *the lowest levels of reflex* activity an impulse that is inhibited and rendered non-effective . . . *may perhaps exert* some influence in determining the future behaviour of the receptive synapse. . . . But on the higher physiological planes, impulses which are precluded from exciting sensation, are not wiped out, they may produce profound and manifest effect, though *they cannot excite consciousness.* The postural impulses normally reach the cortex and evoke sensations of the position of various parts of the body in space. But if they are prevented from reaching the cortex the patient may be entirely ignorant of the position of his affected limbs, *and yet the motions of these parts are perfectly co-ordinated.*" (Italics mine.)

items which it had left behind (as other bathers leave their clothes) on plunging into Lethe. Where did those items (thoughts, facts, intentions), or rather the processes connected with them, reside in the meanwhile, i.e. while we were fast asleep? Surely in the Body. And *mneme*, that beneficent guardian of our existence, going to and fro between what we call our body and what we call our soul, may be supposed to have taken charge of, or at least subsequently restored, whatever valuables that intermittent, and oh, so superficial, Mind of ours had, for the time being, lost sight of.

This being the case—and here comes in my second disagreement with Mr. B. Russell—whether or not the presence of mnemic phenomena be a *sine quâ non* of Consciousness, they can scarcely be its "characteristic" or differentiating sign, since mnemic phenomena are apparently present (perhaps ultimately to be called chemical or mechanical) in our bodily life. Indeed, they may, it seems to me, be reasonably supposed to mediate on occasion between those two rival camps into which common sense and philosophy have both found themselves obliged to break up our existence.

X

SEMON'S "ENGRAM"

LEAVING the relations between the Mneme and Consciousness to philosophers undismayed by the contradictoriness of philosophical terms; and to physiologists who, like Dr. Head, are enlarging our positive knowledge by experiment even in their own *corpore nobili*, I find I cannot close this introduction without touching on two more points characteristic of this *Mnemic Psychology*. Of these one is Semon's conception of the essential mnemic item, namely, the *Image*. The second point is the terminology [1] which Semon invented for his statements and problems. These two points are best treated together, inasmuch as they shed light upon each other. Since it is only by the substitution of such specialized terminology for everyday words, either distorted from their normal meaning or charged with irrelevant, misleading connotations, that we can accustom ourselves to think—well! of just the subject in hand. And nowhere more so than when that subject is *Consciousness*, our scanty notions of which have been almost hopelessly obscured by the metaphorical language of those who have tried like, for instance, Mr. Holt [2] to enlighten us about it.

And it just happens that part of Semon's doctrines, though not the part I have dealt with, obliged him to

[1] I myself have employed it as little as possible, substituting inferior but familiar terms, because I did not want to puzzle and distract the reader's attention by newfangled words whose precise meaning and employment he could not possibly learn in the brief space of this preface, but will become familiar with in the course of the following translation.

[2] *The Concept of Consciousness.*

devise a terminology which left out the whole of that bad business of Consciousness. For, as Semon, like Hering (and for that matter also Butler), claimed that what he called *Mneme* is the conservative principle *in all organic change*, this terminology of his deliberate invention had to be made applicable equally to mental and to bodily phenomena, from one of which two classes it enables him to pass and repass freely and intelligibly, disregarding everything except their mnemic aspects. Thus, when Semon speaks of *oberbewusst*, he is merely comparing the more and the less lucidly Conscious, that which is in the focus with that which is on the fringe of attention. And similarly the *Unconscious* is for him merely another way of saying the *physiological*. Of the various storeys, or residential flats, sometimes with several apartments on the same landing—into which Freudians have divided the (perhaps not always "desirable") mansions of Consciousness—of the *fore-conscious*, the *co-conscious*, and the *sub-conscious*, let alone that basement, pantechnicon, or sewer, called the *Unconscious*—Semon never says a word, although I cannot but think that his intended *Pathology of Mneme* might have reorganized or demolished some of these questionable dwellings of the soul by the application to them of mnemic principles and mnemic terminology. Be this as it may, his method and nomenclature answer to what Mr. Kirkpatrick had asked for in his *Genetic Psychology* (page 203), when he wrote: "Terms indicating the process meant, but not necessarily implying that it is with or without consciousness, are necessary until we know more regarding what kinds of processes may be performed without consciousness; and what kinds must be so accompanied, and in what stages of development and under just what circumstances must consciousness continue to be present in order that the process may be performed . . . either in the same or in different creatures."

Having dealt with this first point, it will be easier to understand the second one, namely, Semon's conception of the *memory image*. His utter elimination of that

awkward and misleading word *Image* will be a blessing even to those who do not, like myself, suffer from a constant abortive effort to SEE an auditory or motor *image* as if it were a visual one. It may, with equally good effect, discourage the pretty common type of reader who, finding himself able to understand M. Bergson's unceasing figures of speech, imagines himself to have understood M. Bergson's often elusive and occasionally gratuitous hypotheses, and, for instance, his alternate use of the word *chose* and the word *image*. Now you cannot juggle in this way with the word *Engram* or *Engram-complex*. An *Engram* (or an *Engram-complex*) may indeed belong either to bodily or to mental phenomena, and it may exist equally in any "field of sensation" as a result of various kinds of stimulation and as a component of various functions or perceptions; but that is just because what makes an Engram (or Engram-complex) an Engram (or Engram-complex) is simply and solely its answering to the exclusively *mnemic* possibilities given under the two mnemic laws whose formula I once more transcribe from Mr. B. Russell's translation of it: "The Law of Engraphy is: All simultaneous *excitement in an organism form a connected stimulation-excitement complex, which as such works engraphically, i.e. leaves behind a connected engram-complex which in so far forms a whole.* The second mnemic principle or Law of Ecphory is as follows: *the partial return of the energetic situation which formerly worked engraphically operates ecphorically on a simultaneous engram-complex.*"

Engram, engraphy, ecphory, acoluthic, homophony, and all the rest, are abstract nouns and adjectives or verbs which have been invented for the sole purpose of describing, classifying, and thinking-out occurrences which may be either mental or physical, in so far, and only in so far, as these occurrences present mnemic characteristics. And the chief characteristic of the mnemic element is that it remains merely *potential* unless elicited by appropriate present stimulation, whether from the outer world or from the inner one, from Le Dantec's *sac de cuir*. "An

Engram," says Semon,[1] "is a latent remnant of the former action of a stimulus" ("*Latentes Rest einer früheren Reizwirkung*"). That means that an *Engram* represents the possibility of a certain kind of repetition when conditions are such as to produce its *ecphory*. And the essential corollary of the whole mnemic theory is that until that ecphory (as distinguished from any physical modifications that ENGRAM may or may not be eventually referred to by advancing knowledge), until that act of Ecphory, the Engram, exists solely as a potential entity and one which, failing the needful *ecphoric* conjunction of circumstances, may even cease to be potential. To ask about such a merely potential entity WHERE IT IS is somewhat on a par with the riddle about Noah's whereabouts *when he blew the candle out;* although a more dignified answer may be given in Seneca's two lines:

> Quæris quo jaceas post obitum loco?
> Quo non nata jacent.

Furthermore, and this, I think, is the great philosophical merit of Semon, he conceives all mnemic phenomena as turnabout results and factors of ceaseless transfer and change. According as we focus our attention, an engram may be either the starting-point or abutment of a set of processes; it may be in the centre or on the periphery of a multifold of conservation and alteration.

This being the case, an Engram (or *Engram-complex*) cannot conceivably be invested with the unchanging, the immortal, status which Bergson attributes to his metaphysical "Memory"; and the Freudians bestow upon an "idea," an "experience," and especially a "desire." From the point of view of mnemic psychology, if any of these last-named entities can be shown to have a continued or recurrent existence, this can only be as a succession of partially similar, but far from completely coinciding (let alone identical!) mnemic phenomena. So the *Libido* manifesting itself in the neurosis of the Slippered Pantaloon is as much the result of his present senility

[1] *Mneme*, p. 181.

and of his intervening years and habits as of the *Repression* which took place when the old gentleman was a puling (and presumably *inzestuös*) infant in the arms of some Jocasta of a mother. Otherwise Time would have come to a standstill, and there would have been neither Puling Infant nor Slippered Pantaloon, nor *Libido*, nor repression, nor neurosis, nor Freudian theory. In short, *mneme* is a word which implies *Time* and *Change*. *Mneme* does not signify recollection any more than forgetfulness, but interchange of both ; not sameness, nor otherness, but a continual mingling, alternating, integration of the two.

The existence of *Mneme* means that there is an active response of whatever lives to the activities of the universe ; it means that there must be repetition, but that repetition can only be partial ; hence it explains not only similarity, but even more, diversity : it explains conserving, altering, being altered ; and also such transformation as is equivalent to vanishing.

Above all, and to end off on a last and a small point, but which has to be mastered by the student of *Mnemic Psychology : Mneme* is not another word for memory, nor synonymous with the *act of remembering*. *Mneme* is simply an abstraction under which we can group, and thanks to which we can study, and even a little understand, *memory* as such, and likewise (as I have tried to sketch out in this preface) several other peculiarities of feeling and thinking creatures, even if not of all living, growing, and reproducing organisms.

VERNON LEE.

New Year, 1923.

PART I

FIRST CHAPTER

DEFINITION OF THE SUBJECT. SENSATION AND EXCITATION

UNDER the title of "Mneme," I have discussed a special section of the physiology of stimulation for which, as a distinctive rubric, "Mnemic Excitations" may also serve. In that work not mnemic excitations alone, but also the original excitations which in a certain sense may be described as their indirect cause, were investigated by me on the standpoint of the reactions through which we become acquainted with them. These reactions are on the one hand subjective (so-called), that is they are sensations which we receive directly and observe introspectively as, for instance, definite sensations of sound, colour, or pain from which we infer a condition of excitation in some particular part of our irritable substance; on the other hand they are objective (again so-called), the effect, that is, of indirect perceptions, arising, of course, ultimately from sensations, by which we become aware of excitations in particular portions of our own or of other organisms. These objective reactions may be expressed in motor or plastic vital manifestations as well as in metabolic phenomena.

The present work likewise deals with mnemic excitations, with the conditions under which they arise, and the course which they run; and, wherever feasible, our study will be confined to the excitations of which sensation makes us directly aware, and we shall treat them only so far as they are thus evidenced. The latter limitation, however, cannot be an absolute one, since the results of experimental psychology must also be reckoned with.

We propose yet another restriction by concerning ourselves in our present investigation only with the mnemic excitations or sensations whose "ascendants" are in the form of original excitations in the individual life of the organism and thus, in my terminology, spring from its individually acquired, not from its inherited, engram-store. I reserve for another occasion and place the discussion of the interesting and difficult question, Whether mnemic sensations that reach the threshold of consciousness can be ever ecphorized or educed from the inherited engram-store? In this work the engram-store as acquired by the individual will alone be studied, with the consequent exclusion of all problems of heredity, although, as we shall find, later, the solution of these will be led to by our present undertaking. As to the existence of particular excitations I have said above, and explained in different passages of *Mneme* that we infer them on the one hand directly from the experience of particular sensations, on the other hand indirectly from objective reactions of which we become aware through sensations. Sensation is, in our view, therefore, directly or indirectly the manifestation of an excitation. But what is their mutual relation? Before embarking on our proper theme, our attitude to this question must be defined, but the following explanations are not to be taken as exhaustive—space for this not sufficing—but merely as aiming at an understanding with the reader.

How then is sensation related to excitation? Sensations are to us immediate data. Taking the word "sensation" in its widest sense so as to include also what we call "feelings" and applying it to original and mnemic sensations, our whole inner and outer world appears as built up of sensation-elements. These are the fundamental data given to us. They are the "known," not to be defined by reference to anything simpler or better known. Excitation, on the contrary, is deduced, inferred. Under that name we understand a particular state of a body —of an organic body—a particular state of that body's irritable substance. Before asking ourselves, then, What

is the relation of excitations to sensations? we have to come to a clear understanding of the more general question of the relation between bodies and sensations. Here I would answer with a quotation from Mach.[1] "The Physicist says: 'Wherever I turn I find only bodies and movements of bodies; I find no sensations. Sensations must therefore be something *fundamentally* different from the physical objects with which I come into contact.' The Psychologist accepts the second part of this affirmation. He is concerned, in truth only with sensations, but accompanying these is a mysterious physical something which according to the above view is altogether different. But what, in reality is the mysterious something? Is it Physis or Psyche? Or may it be both? It almost seems to be both since first one element, then the other, shrouded in impenetrable darkness, eludes us. Or are we being led round a circle by the Evil One? I believe that to be the case." But Mach himself does not recognize any such sharp contrast between bodies and sensations, for in another place he says: "I see no contrast between the physical and the psychical, but only identity. In the sensory sphere of my consciousness every object is at once physical and psychical."

What we call a body is given to us first and immediately as a group of sensations, as a relatively, but not absolutely, permanent complex of colours, sounds, pressures, etc. This complex of sensations, not in the case indeed of the new-born babe in whom there is no concept of a body,[2] but in that of every relatively more developed human being, is composed of original and mnemic sensations (under certain circumstances of the latter alone). Our concept of a body is therefore the result of a very intricate but simultaneously executed synthesis of sensations.

[1] E. Mach, *Die Analyse der Empfindungen*, 4 Aufl., 1903, S. 36.

[2] How far the essential syntheses necessary for the constitution of this concept are determined by the nature of the inherited engram-store, is a question as interesting as it is difficult to answer. I look upon a certain inherited determination as probable, but cannot go into the question here.

The concepts " organic bodies " and " sentient substance " of an organic body only represent particular subdivisions of this synthesis of sensations. In speaking of excitations as being inside such a complex we are referring to some energetic process in the irritable substance of an organic body. This energetic process—we can speak of it in a general manner without defining its specific nature—is no immediate sensation but something we infer from a considerable number of sense-perceptions. We attain to the assumption of an excitation in the irritable substance of an organic body by means of an extraordinarily long series of sensation-syntheses. At the end of this prolonged and complicated route what we find on closer analysis are sensations only—some original, others of a mnemic nature—but no other elements. Thus there can be no unbridgeable gulf between sensation and excitation. What there really is then is the far-reaching distinction between the directly " sensed " and the indirectly inferred—a distinction of which the importance will be made clearer by concrete examples.

Up to now we have spoken only in a general way of the relation between sensation and excitation. But there are, as we know, convincing grounds for assuming that a particular process of excitation in the sensitive substance of a subject corresponds to each concrete sensation ;[1] for instance every original visual sensation is accompanied by processes of excitation in the retina, the optic nerves, and certain cerebral convolutions and so—*mutatis mutandis*—with all original bodily sensations, while the same is true also of mnemic sensations. Observation of pathological cases and experimental researches have conclusively proved that a process of excitation in the brain corresponds to each process of mnemic sensation. And, on the other hand, we know that we become aware of processes of excitation in our irritable substance under circumstances in which there

[1] The sense in which we are to understand " corresponds " will be made clearer as our explanation proceeds (cf., to begin with, the following pages).

is no direct conscious sensation but only manifestations following on objective reactions of some sort.

I tabulate as follows the possibilities of the case. Excitation inferred:

(1) In consequence of a direct sensation;
(2) In consequence of indirect knowledge due to objective reactions (motor, plastic, or metabolic phenomena);
(3) As the result equally of direct sensation and of indirect sense-perceptions.

Numerous objective experiments have enabled physiological research to show that between a directly received sensation and the always indirectly inferred excitation which the sensation manifests, there is found (setting aside, to be considered later, the different conceptual contents of the two) a far-reaching concordance in every other kind of relation, especially in the temporal course, that is to say, the way in which each arises, endures and ceases, and in the degrees of intensity exhibited. Many incline to see in this concordance something peculiarly wonderful, requiring special emphasis and a particular nomenclature. This astonishment is explicable in those who regard sensation and excitation in general and a particular sensation with its corresponding excitation as two absolutely distinct things, but to us the agreement is self-evident. *We*[1] *see in an excitation and its manifestation in sensation not two phenomena to be considered* but one phenomenon contemplated *from two different points of view*;[2] that is to say as sensation from the

[1] E. Th. Fechner was the first to adopt this opinion, and to illustrate it by a well-known and oft-quoted comparison.

[2] It is for this reason that I do not advise giving the name of "psycho-physical parallelism" to this relation between sensation and excitation. I see no use in the term "parallelism," which suggests the idea of two distinct processes running alongside of each other. Thus a false conception might arise from the word, and where a fundamental question is concerned a term leading to misunderstandings can do endless harm.—*Vide* A. Forel, *Festchrift für J. Rosenthal.* Leipzig, 1906.

standpoint of a direct process of consciousness, and as excitation from that of the highly indirect syntheses of sensation through which we are brought to recognize complexes, of colours, sounds, pressures, and so on, as bodies. And, since we distinguish between rest and movement in these bodies and so acquire a standard of work performed, we are further able to formulate such ideas as display of energy or energetic process.

When we define excitation as the particular energetic process of the irritable substance of an organism we attach, as has been said, to the idea a meaning or a content which is the outcome of a long series of abstractions and combinations leading to this conclusion through numberless elements of sensation. How entirely we are justified herein there is no need to explain further, but, on the other hand, we must not forget that this concept is our own creation and results from innumerable syntheses of sensation.

Keeping this activity of our own in view, we cease to wonder that a sensation such as that of light and the excitation corresponding to it (that is, the energetic process in the retina, the optic nerve, and the visual area of the brain) have altogether unlike contents for our consciousness in spite of all other coincidences. *Here* we have the sensation of light ; *there* the energetic process in a special portion of our irritable substance. We have contributed actively to the formation of the new conceptual content, and the difference between excitation and its corresponding sensation follows of itself.

So much in explanation of our view that a sensation and its concomitant excitation are one and the same process regarded from different standpoints. The difference of view consists simply in this, that introspection is directed to the immediately felt content of sensation, but the energetic process presents itself as the product, through abstraction and combination, of very many indirectly linked sensations. Small wonder then, that the common object is reflected in consciousness quite differently according as it is regarded.

For the rest, as regards the conditions and manner in which a sensation and its corresponding excitation come about, there exists a far-reaching conformity between the two, and so it is also with their intensities. This conformity is, of course, complete whenever a given excitation has been inferred from the existence of a given sensation. The case is somewhat different when the particular excitation is inferred not merely on these simple grounds, but also because of the corroboration of other facts, some directly, others indirectly, ascertained.

It may, for instance, happen (and we shall meet with not a few similar instances as we go along) that where various reasons have led us to be absolutely certain of the presence of two comparatively separate (discrete) excitations, the two together are nevertheless manifested by a single direct sensation. Such cases formerly led to the belief that " physical " excitations remain separate while in the " psychical " sphere there is a fusion of the sensations following on those excitations.

But for us this is a question of different points of view. For us excitation and sensation cannot possibly stand in the relation of cause and effect because we consider them merely as the same objects taken in from different standpoints. It is easy to understand that this difference of point of view (quite apart from any other differences in the mode of perception of that object) occasionally results in other differences.

I will illustrate this by a comparison. Two objects can be seen by an observer under such physical conditions that one covers the other. The observer, however, by shifting his point of view, distinguishes them successively as two, but the first and the second observation do not contradict, but simply complete and extend, one another. Of course, the difference in the point of view is not so great if I look at an object from two different sides, thus comparing two direct complexes of sensation, as when I compare a direct sense-perception with the concomitant excitation which it makes me infer. But the two cases tally in what we are for the

moment regarding as essential. To think of the excitation, that is to look at the process from its energetic side, means that we are regarding the data of our observation from every possible point of view; and the effect of this general survey must always be in harmony with observation from a single standpoint. For the single standpoint, which in our case is the immediate sensation, must be reckoned with, and the total result corrected through it. A contradiction is consequently altogether impossible. The result of a general view will be more comprehensive merely, and contrasted with the single aspect will contain more. It follows for our assumptions that there is no contradiction in the fact that under certain circumstances we are compelled to predicate the existence of two (or more) distinct excitations when without doubt there is but one manifestation of sensation for the two irritations. In the course of our investigations we shall meet in various connections with similar cases, and although we may treat of sensations in every province of sense we must, in conformity with the comparison we have mentioned, speak, when this happens, of the overlaying of one sensation by another.

The contrary can never happen; we shall never have to assume the existence of only one excitation for two distinct manifestations of sensation. For it is one of the principles involved in the idea of excitation as it results from our studies in the physiology and pathology of stimulation that one separate sensation points to the existence of at least one "energetic" process in the stimulable substance. The contrary assumption would be in contradiction to one of the premisses underlying our concept of excitation—a premiss which was the very starting-point of the concept.

I now leave this subject in the exposition of which I have perhaps seemed to dwell chiefly on self-evident propositions. But a clear survey of these self-evident propositions is a chief condition for the understanding of fundamental problems to be handled later, especially for the right conprehension of homophony

Now we are taught by the history of the physiology of stimulation as well as the pychology of sensation that hardly anything is more confusing or a greater hindrance to progress in grasping general connections than the failure to understand such self-evident propositions.

In several places of our preceding statement we have explained that sensation is the direct fact of consciousness, while the excitation thereby manifested is the result of much indirectly acquired knowledge.

But the first part of this proposition, that namely which refers to sensation, requires some limitation and elucidation. In point of fact what we experience immediately are not single sensations but connected complexes of sensation, forming at any given moment the whole content of consciousness. We do, indeed, distinguish differences in this content; it is not homogeneous but its various components are more or less intertwined. A comparison with human or animal organisms serves well to illustrate this relation. Our body constitutes a continuously held together, but not homogeneous, whole which an anatomist artificially disintegrates when separating muscles, nerves, and blood-vessels, one from the other. The organs thus presented and regarded as independent entities are artificial products, of which, however, the creation is amply justified since it alone offers a way through the bewildering complexity of the body as a whole. Nevertheless the arbitrariness of the conception arrived at by this process of selection must never be lost sight of nor the artificial products ever regarded as natural wholes. We are precisely in the same condition when analysing the content of consciousness. Only by analysis can we study it properly; and in analysing we have to undo connections and arbitrarily establish boundaries which have no existence in reality. A closer examination in the next chapter will show this more clearly, and we shall then see the impossibility of establishing any criterion by which to resolve the content of consciousness into natural elements, into elementary sensations. We shall recognize that such an undertaking is possible only

when we follow the example of the anatomist who applies arbitrary methods to the analysis of the human body. But just as every analysis of the content of consciousness can only produce artificial results and as every single sensation is found to be given not directly but only as the product of an abstraction, so also the grouping of components into different co-ordinated "basic forms" and the comparison thereof must always result from a standard fixed by the investigator, for it is unavoidable that in places natural combinations will have been undone and arbitrary barriers set up.

If therefore many psychologists divide the co-ordinated basic forms of psychical elements into four (or more), others only into three, co-ordinated categories, namely sensations, feelings, and images, while others are satisfied with a still smaller number, this is more or less an affair of personal choice. For my part I agree with those pychologists who consider that there is need for only *one* class of psychical elements, namely *sensations*—looking upon feelings as a specially differentiated kind of sensations or disturbances of sensation, and treating images, as we shall see later, only as a particular class of sensations. On one point, however, there is agreement among all scientific psychologists, viz. that a simple, an elementary, feeling cannot be imagined as arising independently of sensations nor as existing isolated alongside of them. "Pain and pleasure[1] can properly be called sensations, but they cannot be so well or so easily analysed as the specialized sensations, and are perhaps not limited to so few organs. Painful and pleasurable sensations are an essential portion of all so-called feeling. What we are conscious of when aware of feelings can be described as more or less diffused, not definitely localized, sensations."

There are psychologists who, not satisfied with separating pain and pleasure from other sensations and describing them as feelings or, when inextricably bound up with other sensations, as emotional emphasizing of these sensations, apply an essentially stricter principle of

[1] See Mach., p. 17, *ibid.*

delimitation. For them feeling is a constituent of sensation, but the constituent of which we are conscious subjectively, while the other constituents of the sensation are referred to some object of the outer world or, under some circumstances, a certain portion of our body considered as outside the whole remaining ego. For instance (according to the above view), when I have a piece of sugar with its constituent sensations of angularity and sweetness on my tongue, what I *feel* is the *pleasantness* of the sweetness, that being the element especially affecting my ego. And so again with organic sensation: my lip is swollen; I feel it to be stiff and hot and throbbing, and all this is disagreeable to me, and it is this disagreeableness out of the whole complex of sensations which affects my ego, while the remaining components of the complex are referable to my lip which thus becomes an object outside my ego. It is evident that for many undecided, dull sensations, especially in the innermost organs, this definition offers many difficulties which do not occur in the definition of pain and pleasure as accentuations of feeling. On the other hand it is true that such sides of sensation as are accompanied or followed by inner experiences of tension or relief, excitement or appeasement, can be brought under the heading of emotional accentuations in these sensations, while it is often difficult to range them entirely as pleasure and pain although they are rarely completely free from such admixtures. But whatever definition one may select, there is no imperative reason why either emotional emphasis or sensation of pain as such should be looked upon as separate elements instead of as part and parcel of sensations.

As already remarked in the opinion of many, if not most, of the more recent psychologists there can be only two kinds of separate and independent psychical elements namely: sensations and images.[1]

[1] Both here and in what follows the expression "image" must be taken in the narrow sense of representation either in memory or in imagination, as the term is employed by a large proportion of modern psychologists, as opposed to the much wider meaning

The representatives of these two groups (i.e. sensations and images) of components of consciousness differ distinctly from one another in two respects · first in their quality, the way in which this quality presents itself to consciousness ; secondly in the manner of their production. Only if an exhaustive criterion could be derived from the first of these differences should we refuse to reckon the so-called images with sensations. But this is not the case. It is true that in the majority of instances there is no difficulty in immediately recognizing original sensations, owing to their much greater liveliness (" vividness " I would say, as distinguished from intensity), and in separating them from their far paler images. But, as will be better shown in the twelfth chapter, this differentiation is by no means thorough-going. It fails as soon as one tries to use it as a boundary-line. In cases which are not rare and under circumstances not to be called abnormal it is impossible to make a direct distinction between original sensations and so-called images, and we must conclude, therefore, that both kinds of these components of consciousness should be included under one collective name, and can only be distinguished by qualifying terms referring to the differences in their mode of origin. The only appropriate general term appears to me to be " sensation," for it is a fact of consciousness that a lively mental image is truly " sensed," just as a pain recalled in thought is truly " felt."

A satisfactory measure of difference between the two sorts of sensation as immediately present in consciousness is not to be obtained from their own quality, but we do find it in the quality and mode of their production. This does afford a comprehensive criterion, and which, in connection especially with what I wrote in my *Mneme*

given to it by B. Wolff, Kant and Herbart, who make it cover all intellectual contents of consciousness. Wundt (*Grundzuge der Psychologie*, Bd. I, 1902, S. 345–7) applies the wider meaning; but the use of the same term for two fundamental ideas so differently defined has naturally been the source of countless confusions and misunderstandings.

on the subject of excitations in general and their modes of manifestation, I should like to formulate as follows: The production and survival of a particular complex of original sensations is dependent on the presence and duration of a particular complex of stimuli. The production of such a complex in the shape of mnemic sensations (often, though not necessarily, almost as lively as their original predecessors) only requires the presence of a fragment of the complex of stimuli, or even of one only of the forerunners. How long any given mnemic group of sensations is able to last does not depend upon the duration of the particular stimulation by which, directly or indirectly, it has been elicited or, as I shall henceforth express the phenomenon, " ecphorized " (educed). What the duration of this ecphorized mnemic complex does depend upon is, in the first instance, the duration of the original sensations which have been its indispensable predecessors. The details of this part of our subject will follow in my twelfth chapter.

To recapitulate: We recognize as (always more or less arbitrarily isolated) elements of any given contents of consciousness only *sensations*, and we consider what are called feelings not as specific elements but only as shades of sensation. These sensations we divide in the widest sense into original and mnemic sensations for which the criterion of differentiation is found only in an indirectly ascertainable factor, namely the manner in which they are produced and preserved. The directly ascertainable distinction of greater or less vividness does not hold good throughout and can therefore not be applied to cases which lie in a borderland.

Considered from the standpoint of energy, original sensations correspond to original excitations; mnemic sensations, to mnemic excitations. We have described original sensations as the forerunners of mnemic ones, and the dependence of the one upon the other is such that 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 pre-condition for the study of mnemic sensations that we should closely follow the orientation of certain aspects of original sensations, because the former are dependent on the latter as inevitable predecessors, and also because they often have a share in the ecphory (eduction) of the latter, combining with them into new wholes.

In turning now to a closer study of original sensations we do not propose to pass in review all that is already known to us through physiological and psychological research into the senses. The enormous material on both sides collected up to now will only be used by us in so far as the knowledge of it is necessary for a proper understanding of mnemic sensations. But the very questions we shall raise are just those which are barely, if at all, touched upon in works on the physiology and psychology of the senses, so that we shall not be treading familiar paths, and our study when not resulting in new solutions may at least suggest new problems.

SECOND CHAPTER

SYNCHRONOUS PHASE: SINGLE SENSATIONS AND COEXISTENCE OF SENSATIONS

WE may usefully preface our investigations by briefly recapitulating some results to which we had already arrived in *Mneme*. In it[1] excitation was defined as "energetic action on the organism such as results in sequences of complex changes in the irritable substance of that organism. To this alteration in the organism, an alteration which lasts as long as the stimulation producing it, we gave the name of synchronous phase or excitation. What the essential nature of such a state of stimulation may be we do not know. All that we do know are a few of the accompanying factors of the process and some of the manifestations of the vast number of changes characterizing this condition of excitation. And we are accustomed to consider as reactions of the organism to the stimulation every manifestation connected with the excitation, whether those manifestations be directly or indirectly connected with that excitation.

"The changes following on excitation can happen throughout the various categories of organic action whether in the sphere of metabolism (chemical reactions), in that of changes of form (movement and growth), or in that of consciousness (sensation). As regards the last-named kind of reactions we have direct knowledge of them only in our own organisms and through our own consciousness."

I describe as the synchronous effect of irritation that

[1] 2 Aufl. S. 15.

which follows immediately or almost immediately on the irritation and comes to an end with it; and I call a synchronous phase of irritation, i.e. sensation, that which the aforesaid synchronous effect conditions. Upon this there follows instantly on the cessation of the stimulation a phase of decline to which I give the name of acoluthic or attendant; and the excitation or sensation, consisting of the joint synchronous and acoluthic phase, I describe as the *original excitation* (i.e. *original sensation*).

The synchronism between the duration of a stimulation and its contemporaneously manifested excitation must be understood as approximate only, because the excitation manifests itself only after a measurable, though usually very brief, interval after the excitation has begun and ceases similarly a little after the excitation is over. This is as intelligible as that an electric bell sounds the fraction of a second after pressure by the finger and stops ringing with a similar interval after the finger has been withdrawn.

The better to connect these questions with my arguments in *Mneme*, in the first chapter of which they are exhaustively considered, I have so far handled them only on their energetic side. So much is necessary as soon as one tries to define the concept of excitation, that is to say, as soon as one seeks to reduce to a fixed formula those external causes of one's own direct sensations which we are accustomed to describe as excitations. In this procedure it becomes natural to say that a stimulus, in other words a particular energetic process, sets up in our sensitive substance an excitation, that is to say, a secondary energetic process which is revealed to us by a corresponding sensation. But what are we to understand by *a*, in other words a single, sensation? We have already explained in our first chapter (pp. 65–66), and can now demonstrate more particularly, that it is obtained by an arbitrary, a deliberate splitting-up of what is a natural unity, namely, a total content of consciousness; and we disintegrate this unity without being able to define otherwise than arbitrarily the elements into which we reduce it.

This content of consciousness, that is to say, this complex of sensations, is the direct datum, the true psychical experience ; the separate sensation, on the other hand, is an abstraction never realised as an independent happening. But, of course, it is not always an abstraction based upon complicated operations of thought but quite as often a process which the most unsophisticated human creature can accomplish automatically by what may be called reflex action. If at a performance in a theatre or a concert the person behind me sticks a pin into me I feel the local effect of pain as something quite distinct and apparently altogether unrelated to the optical, acoustic, and other sensations aroused in me at the moment. It will probably be supposed that this pain should be described as an experience totally distinct from the remaining sensations. But if we avoid such special cases and take a general survey we find that, as a rule, the delimitation and extrication of a particular sensation out of a whole simultaneous complex is an act of volition, and that a fixed measure or any rule for the delimitation is not discoverable.

Let us now seek for a principle of the splitting up of a simultaneous complex, the principle admitting its dissolution into the elements of some particular sensation, for instance, the sensation of sight. We are, we will suppose, looking at a wall covered with red and gold paper and occupying the whole of our field of vision. That arouses a complex of optical sensations, among which we distinguish red and gold components, a maze, a peculiar network of golden arabesques in relief on a red ground. Are we to say that the elements of this complex of sensation are respectively the elementary sensation of red and gold ? But in the whole pattern of gold arabesques some parts are representations of flowers, some of leaves, some of fruit. Are these to be regarded as yet more elementary units ? On looking closer we see that the gold tone itself is not undivided, but is built up of neighbouring palettes, some dense, some glittering. We can thus separate the visual complex into smaller and smaller

elements ; and such a continual subdivision of an optical sensation-complex into ever smaller elements can be carried on in appropriate objects as long as we are able to distinguish and separate their contiguous points from one another, or, to speak in terms of physiology, as long as these different images fall upon two distinct rods of the retina.

Again, in the sphere of skin-sensations, we should be similarly obliged to recognise as separate elements of sensation those constituents which can be referred to separate sensitive spots corresponding to pressure, temperature or pain. But in the vast majority of cases it is only under laboratory conditions that such elements can be extracted absolutely unmixed. In our ordinary mental life we come across them only by exception, and they are thus far from representing what the unlearned consciousness is accustomed to regard as a simple sensation. Anyway, it is possible that we have here a means for the natural analysis of sensations, and we might say that in reducing a complex of sensations into its natural elementary components each of these becomes so characterized that its release is to be ascribed to the excitation of a special bodily element—a terminal nerve-organ. When thus seeking to separate the different elements of sensation we are clearly adopting a criterion not furnished directly by the investigation of sensations as they arise, but one which we reach only through the indirect method described in the preceding chapter. That is to say, we deduce it from numerous observations made at different times—from numerous indirectly inferred connections. We shall see later that while the criterion so obtained is by no means insignificant it yet provides no material for the understanding of direct consciousness or of the natural unities of sensation. This criterion is, moreover, to be rejected especially for the analysis of elementary sensations in cases where a large or small group of absolutely contiguous terminal nerve-organs are subjected to one and the same excitation. We are aware, for instance, of one continuous patch of colour or of one peculiar

pressure, but the disintegration of such a sensation into as many elements as might correspond to distinct rods in the retina for the coloured patch, or to different points of pressure in the area of touch, is in entire contradiction with our real experience. For if I apply equal pressure to a space of skin measuring a square centimetre, and thus irritate twenty pressure-points, the sensation which follows is not that of twenty combined elements but forms one united impression in which the separate points of pressure only play a part in peripheral delimitation, but are of no help in analysing the product of sensation. Consequently, what a careful consideration of the mode of arising of sensations supplies is a key, not to an analysis of elements, but to an understanding of the discrete co-existence (or side-by-sideness) of sensations. Nevertheless, it may perhaps be thought that if a thorough separation of the different components of sensation in a complex belonging to one and the same province of sense be impossible yet a certain instinctive analysis of the whole simultaneous content of consciousness [1] does take place, inasmuch as we are absolutely able to distinguish between acoustic and optical sensations, and to separate these again from those of pressure, temperature, pain, smell, and taste. But even this does not hold good entirely, for the sensations of taste and smell are usually so welded as to seem but one complex to our consciousness. We are accustomed constantly to designate as taste what is really a mixed product of taste and smell when our mouth (by means of the hinder opening of the nasal passage) enables us to perceive the olfactory components of the whole complex. (This is a subject to which we shall return more fully.) Again, the sensation of pain affects quite other points of skin than those involved in pressure

[1] Here we are considering chiefly the primary components of the content of consciousness, but everything which we have said regarding these applies equally to mnemic sensations and to the mnemic constituents of the content of consciousness, as will be clearly explained in the ensuing pages, as a result of the development of our investigation.

or temperature, and can easily be proved by experiment to be quite independent, but in practice it is, as a rule, inextricably bound up with the other dermal sensations, so that pressure and pain in the case of a violent thrust are felt indistinguishably, the pain seeming pressure and the pressure pain. Painful extremes of heat and cold, also, are felt as separate sensations of pain and temperature respectively.

Summing up, we can therefore say: Neither by classifying sensations according to their quality or modality nor according to the locality wherein they originate are we able at any given moment to disintegrate, except arbitrarily, the elements of a combined content of sensation, of a simultaneously constituted complex. The reason of this is that consciousness is from the outset an undifferentiated, if not homogeneous, unity.

What our simple consciousness apprehends perhaps as a single sensation—as a spot of colour of such-and-such a size, a tone with all its over-tones, a painful pressure of so-or-so many centimetres in extent, a sensation of temperature, or the so-called "taste" of a dish resulting on the combination of taste and smell—is something, as shown in my example of the wallpaper, which almost always can be divided into smaller or simpler elements. But, as is easily demonstrable, in every concrete case failure waits on the attempt to disintegrate a simultaneous complex of sensations into natural (that is, into *such*) elements as the consciousness immediately knows to be divisible, and this failure proves the primary unity of any complex of sensations.

The simultaneous complex of original sensations and of attendant mnemic ones, that is of the whole content of consciousness at any moment, is a unity in the sense that it cannot possibly be completely broken up into its elements. We do indeed feel that there is a combination of components more or less numerous; but our consciousness is acutely aware of only a proportion of these as separate, while the remainder are so closely interwoven that they can only be disintegrated by a voluntary

act of delimitation such as does not belong to immediate and spontaneous awareness.

Basing ourselves on our direct consciousness, how shall we best characterize the reciprocal relations of the components of a simultaneous complex? In *Mneme*[1] I said that they arrange themselves in a condition of discrete coexistence (side-by-sideness), and to this definition I adhere. But in prosecuting my enquiries I have come to see that it must not be understood in the merely metaphorical sense to which, not grasping the whole of the question, I at that time restricted my formula in the following remarks: "Discrete coexistence (side-by-sideness) implies literally a spatial relation. Speaking strictly, the only sensations we experience as existing side-by-side are those possessing the spatial quality due to 'local signs,' that is to say, the various visual, dermal, or organic sensations. But as our language admits of the expression 'side-by-side' in a wider than the spatial sense, and nobody hesitates to speak of tones as juxtaposed, I trust not to be misunderstood if I apply the word 'side-by-side' or juxtaposed to the multiple sensation of simultaneous but different tones, tastes, etc.—in short, to every possible co-ordinated sensation."

But, as already hinted, I have now come to use "side-by-sideness" or juxtaposition in a less metaphorical manner, indeed in such a sense that the expression is applicable in the same way to all spheres of sensation. The grounds for this revision of opinion will be made clear by the following considerations. First of all we must ask ourselves, Whether we can discover and formulate a general law connecting the topography of an excitation (what might be briefly called the entrance-place of a stimulus) and the fact of discrete coexistence (side-by-sideness) among the sensations aroused? To this question it is possible to give a short and explicit reply, Whether the manifestation of two simultaneous excitations is in two discrete coexistent sensations depends altogether upon the topography of the two nervous phen-

[1] 2 Aufl. S. 118–22.

omena, on the relation between the two entrance-places of stimulation. Only when two entrance-places are sufficiently distant one from the other can two excitations be revealed as coexistent. There are, as we shall see, cases in which two excitations entering through topographically separate doors manifest themselves not as coexistent but as fused into unity of sensation, as, for instance, when the entrance-places are corresponding points of retina, corresponding spots of the right and left portions of Corti's apparatus, or various points of the epithelium subserving smell. We shall learn later that these apparent exceptions offer us a useful glimpse into the nature of the processes in question, and are quite in harmony with our general conception. But these exceptions do not allow of our formulating that "two excitations entering at different places *always* appear as coexistent (side-by-side), but oblige us to fall back on the more negative formula that this happens when only *two* excitations thus enter, inasmuch as two which enter at the same, or as good as the same, place never appear as coexistent."

As illustrating this remark there is the fact that a simultaneous excitation of the nerves of pressure and pain, or of pressure and temperature, in one and the same point of our body, does not reveal itself as two side-by-side feelings, but gives a unified sensation of pressure and pain and cold or heat, however much pain, pressure and temperature differ among themselves. Equally in the sphere of skin-sensation it is not enough for the entrance-places of pressure, pain, or temperature to be separate in order to produce simultaneously discrete coexistent excitations. The points in question must also not be too close together.

As regards this particular region of sensation, we can lay down as a positive rule that when two points of pressure or pain are sufficiently remote from one another, or when a point of pressure and another of pain, or a point of pressure and another of cold or heat are all adequately separated and simultaneously excited, the resulting sen-

sation is invariably one of discrete coexistence (side-by-sideness).

And as with sensations of pain, pressure, or temperature, so also with the so-called organic sensations and with those of position, movement, or resistance. Sensations of movement are peculiarly interesting and important, but unfortunately the physiology of their production is still a much-disputed question into which we cannot now enter. It is enough to say that as regards discrete coexistence they appear altogether analogous to sensations of touch, so that they might be and, indeed, often are referred to a kind of subcutaneous tactile sense. In any case, they, in common with the dermal sense of touch, may enable each individual to construct for himself what is described as "tactile space."

As regards the coexistence of discrete sensations of taste and their relation to the topography of the excitation processes, I have found no precise statements in literature.[1] But in order to speak with some exactness I have made experiments on the tongue by subjecting it simultaneously to two different liquids dabbed into two different spots under absolutely identical and thermic conditions. When the distance between the two spots of stimulation was not too short and when sufficiently strong chemical agents (always, however, of a non-corrosive sort) were applied, persons with a well-developed sense of taste could perceive two coexistent tastes, not perhaps very distinctly but always with a true discrimination as to locality. When, for instance, an acid solution was used on the right side and a sweet one on the left, never did the left side perceive an acid, nor the right a sweet, taste. Either both sensations were correctly localized and characterized, or if one sensation overpowered the other that one would be

[1] In Fr. Kiesow's experiments on contrasting results between simultaneous sensations of taste (*Beitr. z. phys. Psych. d. Geschmackssinnes*, Wundt's *Phil. Studien*, 10 Bd., 1894), the occurrence of discrete coexistence sensations of taste is certainly assumed, but Kiesow, being busied with researches into contrasted phenomena, has not devoted attention to our particular question.

correctly localized and characterized while the other would be properly placed but indifferently or doubtfully characterized. This was especially the case when the two stimulated portions of the mucous membrane of the tongue were close together. My wife, whose sense of taste is extraordinarily well developed, placed two tastes correctly when the points excited were but five mm. apart, but then the zone experimented upon was the portion of the tongue most sensitive to taste.

However much these observations may be of the nature of mere *obiter dicta*, they yet show clearly that even with respect to sensations of taste, an isolated stimulation in different places produces what I have described as side-by-sideness or discrete coexistence, and that depends as much on the locality of the stimulation process as in the case of the dermal and other sensations above described.

Let us now turn to sensations of sight and hearing. As regards the first, there is a fixed connection between the topography of the stimulation process and the discrete coexistence of sensations; as regards the latter, there is at least a very probable correspondence. Both sensations, however, while corresponding with all others in respect to the relation between separate stimulation-areas and discrete, present a peculiarity distinguishing them from the sensations hitherto dealt with, namely, that while giving the awareness of juxtaposition, they do not furnish a *direct* awareness that such juxtaposition, or indeed their occurrence at all, is due to the excitation of a particular part of the body. Joh. Müller [1] well expresses this with reference to the visual sensations as follows: "Of his eye—in so far as it sees—the new-born babe knows nothing. Indeed, the creature gifted with sight has little means of knowing that it is his eye which sees. Only in cases where we are aware of a sensation in the eye without being aware of a plainly visible object do we remark that the eye is the place where these things happen." The same holds good in acoustic sensations; but we shall return another time to this important subject.

[1] *Physiologie des Menschen*, II, S. 356.

On the whole, however, and returning to sight-sensations, it must be admitted that for them, as for skin-sensations, the locality of stimulation is an integral factor. What corresponds to the various sensitive points of the sense of touch are the various retinal elements (the rods) of the optic-sense. Nay, the dependence of coexistent sensations upon the juxtaposed localization of stimuli can be ocularly demonstrated, as regards the optic sphere, by the fact of an anatomically excised eye displaying an image exactly similar (except for being reduced and reversed) to that which the owner of the eye was once aware of. This fact, together with the circumstance that the image on the retina is perceived, "reversed" by that retina's owner, has given rise to all kinds of problems of illusion which have been investigated by Joh. Müller,[1] E. Hering,[2] and E. Mach.[3] After this there is no need to further explain that as regards sensations of sight the proposition with which we started on these investigations holds entirely good, viz.: "Only two excitations entering at two different places of stimulation (points or rods) manifest themselves as discrete coexistent sensations, while such is not the case when two different stimulations fall upon the same place or on two 'corresponding' places."

And what we have here said of sensations of sight could be applied equally to those of hearing if we had as precise knowledge about the former as about the latter. This is not to say that we have an exhaustive knowledge of the physiological processes involved in the functioning of our organs of sight. But what we do almost know about the topography of places of stimulation and their relation to phenomena of visual sensation suffices to decide the present question. And the same would apply to the organ of hearing if we could base our views unhesitatingly upon Helmholtz's theory of physical

[1] *Physiologie*, II, S. 335–59.

[2] *Beiträge zur Physiologie*, 1861–64, especially the chapter on the "Inadequacy of the Theory of Projection," in vol. II, 1846.

[3] *Beiträge zur Analyse der Empfindungen*, S. 31, 103.

resonances, above all upon his central assumption that every simple tone of a definite pitch causes a particular point of the basilar membrane [1] to vibrate in concert, and thus only stimulates special parts of the terminal nervous organs of the acoustic nerve connected with that portion. Investigation of this problem does, unfortunately, not allow us to accept Helmholtz's theory as final.

We must admit that, setting aside certain physical difficulties (such as the extraordinary brevity of vibration in the fibres of the basilar membrane), which, however, after the researches of Helmholtz and Henson do not seem insurmountable, many of the so-called secondary sound-phenomena in Helmholtz's theory raise serious objections, although it may seem as if later investigations have at least diminished, if they have not removed, these difficulties.[2]

But even among those who entertain weighty objections to Helmholtz's theory of physical resonance, there are many who, as Mach [3] points out, recognize "that in giving it up we lose the item which helped us to understand how sound is analysed and therewith an intelligible theory of tone-sensation." Hence the desperate clinging to the resonance theory. L. Hermann[4] seems to me to have hit the right nail when saying that *some* resonance-theory is indispensable, but that it might not be necessarily a *physical*, but could well be a *physiological*, one. There is plausibility in Hermann's assumption "that the terminal nerve-organs are themselves susceptible to stimulation for a certain period. It need not be a power

[1] Helmholtz first, as is well known, assumed that parts of the bow of Corti were set vibrating in unison with tones; but after Hasse had proved that birds have no bow of Corti, he accepted Henson's theory that the resonant apparatus is formed by the fibres of the basilar membrane.

[2] See, for an instructive and comprehensive exposition of this point, the article on the sense of hearing, by K. L. Schäfer, in Nagel's *Handbuch der Physiologie des Menschen*, 3rd vol., 1904, S. 562–71.

[3] Mach, *Analyse der Empfindungen*, 4 Aufl., 1903, S. 236.

[4] Hermann, *Pfluger's Archiv*, 56 Bd., S. 494, 495 ff., 1894.

of elasticity alone which restores the organ to its original balance."

What Mach here considers as the essential portion of any general theory of resonance, which is essential for our understanding of sound-analysis and tone-sensations, is precisely the adoption of the general principle which we have tried to apply to tone, as to other, sensations. For the real meaning of the word "physiological" when applied to a theory of resonance can be perfectly expressed in our principle that the discrete coexistence (side-by-sideness) of tone-sensations is connected with the localization of the processes of stimulation or, in other words, that such a discrete coexistence exists only when there are different entrance-places or gates of stimulation. Whether the stimulus knocks at a gate by means of a vibration of special fibres of basilar membrane, or by any other means, is of secondary importance. The essential factor is the relation between coexistence and the topographical difference in the gates. But I think we are justified in making this general assumption when we strike the balance of our present knowledge about tone. I leave to another chapter (the fourth) the consideration of a possible difference between sensations as felt in the right or left organ of hearing, because this difference is not manifested by coexistent sensations but in another way through a differential of sensation which tells us whence a sound comes.

Turning now, in conclusion, to the sense of smell, we are confronted with the remarkable fact that our very effete olfactory organ[1] betrays no coexistence among its

[1] The effeteness of the olfactory organ in men and primates compared with other mammals is proved by comparative anatomy, ontogeny, and biological observation. What we notice on this subject in ourselves and our fellow-men must therefore not be taken as the rule for other mammals (the primates perhaps excepted). Still less does it apply to yet remoter forms such as insects, whose organ of smell resides on the surface of their movable antennæ and, as Forel has shown, must, for this reason alone, act quite differently from the fixed, deeply embedded organs of land-living vertebrates. Forel (*Die psychischen Fähigkeiten der*

particular sensations. Two synchronous smells introduced the one through the right, the other through the left, nostril enter into competition, so that we perceive first one, then the other; or there results a mixed smell; or else there is a compensatory effect as has been shown first by Valentin, next by Aronsohn and, more thoroughly still, by Zwaardemaker by means of a double smell-measurer.[1]

It may here be objected that a mixture of smells must often be the same as a coexistence. This is, indeed, not the case with new and peculiar scents to which half a dozen ingredients have contributed, as when the perfumer makes a honeysuckle scent, for instance, out of a mixture of roses, tuberoses, violets, vanilla, tolu-oil, almond-oil and orange flowers;[2] but this does not affect the fact that there are also mixed smells whose components can be distinguished. This recognition, however—this analysis of the sensations of smell—probably rests on the competition already mentioned which allows the perception first of one smell and then of another, and it is certain that in such cases, for the rest not very frequent, there is no discrete coexistence which can be even remotely compared with what we have described as belonging to tactile, visual, and aural sensations.[3]

I do not, therefore, deny every possibility of discrete coexistence in regard to smell-sensations, for the effeteness to which our organ of smell has been reduced renders our perceptions too hazy for any decisive result, and I can but quote the sum of our present experiments without formulating any final conclusion. Nevertheless, I seem justified by these experiments in assuming for the pur-

Ameisen. München, 1901) aptly describes the sense of smell in insects as topo-chemical. I shall return briefly to this subject at page 86.

[1] Zwaardemaker, *Die Physiologie des Geruchs*, Leipzig, 1895, S. 165–74.

[2] Zwaardemaker, *ibid.*, S. 266.

[3] W. Nagel expresses the same opinion in his essay on the sense of smell. See his *Handbuch der Physiologie des Menschen*, 3 Bd., S. 115.

pose of further exposition, that in sensations of smell there is no discrete coexistence (side-by-sideness) which we need take into account.

We have, so far, discussed sensations as coexistent within *one* region only, that of the skin, the eye, etc.; but it is a fact that in one and the same state of consciousness there can be many different sorts of sensation respectively of the skin, sight, hearing, smell, etc., each and all present at the same time. But perhaps objection may be taken to applying the term "coexistence" to simultaneousness in sensations of different kinds, for while sensations of touch and sight are referred to the same kind of space, sensations of tone (setting aside the direction of sound) are *not* felt as having the same spatial reference; and the same might be objected as regards smell. It might consequently be contended that as these different kinds of sensation are not juxtaposed we cannot regard them as coexistent since, properly speaking, coexistence implies juxtaposition (side-by-sideness). This objection will be disposed of in our next chapter and can, therefore, be disregarded for the moment, as the only question at present involved is, Whether one is entitled to apply the term discrete coexistence to the simultaneous presence of separate sensations of different kinds in one content of consciousness? and of this question the solution can wait till after the more special ones under consideration have been disposed of. But whether or not the simultaneous presence of touch-, sight-, hearing- and smell-sensations should be described as coexistence or side-by-sideness, it is certain that the fact we are dealing with depends absolutely upon the topography of the point of stimulation of the skin, the retina, the organ of Corti, the olfactory epithelium, and so on. And even the sense of smell which, as we have admitted, betrays no clear discrete coexistence, no side-by-sideness of its sensations, yet testifies to the fact that such side-by-sideness depends on a separate localization of the stimulation, since its sensations constitute a distinct discrete coexistence with reference to all other sensations, or at least to

the greater number of these. There is, indeed, at times a certain slight confusion between smell and taste, which is perhaps attributable to the considerable deterioration of the human olfactory sense. When in eating we are simultaneously aware of the smell and taste of food the two sensations do not seem to be merely coexistent but are more often completely fused, and what we describe as the specific "taste" of food, of bread or meat, of potatoes or apples, is simply the fusion blending two sensations together referred by us to one of them, that is to taste, and to its gates of stimulation, the tongue and palate.

In principle, therefore, our point holds good. What we find is merely that in our sense of smell the topographical factor (i.e. the peripheral stimulation) is much less defined than in other sensations, much less than in sensations of taste as well as in the dermal sensations of the respiratory nasal mucous membrane, often erroneously supposed to be the seat of smell.

Forel [1] has admirably described how infinitely more acute is the sense of smell in insects, especially those possessing movable antennæ. For in those there is obviously not only an abundant coexistence of sensations of smell corresponding to coexistent antennal sensations of touch, but owing to the numerous regions of touch and smell in common there is also an undeniable beginning of a perception of space which Forel rightly calls a "topo-chemical sense."

Now that by this careful survey of the different areas of sensation we have convinced ourselves of the regular connection between the topography of peripheral stimulation (the gates of stimulation) and discrete coexistence (side-by-sideness) or its opposite in the manifestation of a particular sensation, we can devote ourselves more particularly to the study of this side-by-sideness in the form known to us as the immediate content of consciousness. This will be the subject of the following chapter.

[1] A. Forel, *Sensations des Insectes*, 2nd vol., 1886, p. 51 (German translation, Munich, 1909). See, too, especially *Die psychischen Fähigkeiten der Ameisen*, Munich, 1901, S. 48–53.

THIRD CHAPTER

DISCRETE COEXISTENCE OF SENSATIONS DESCRIBED. CONCEPT OF FIELDS OF SENSATION

OUR task is to examine introspectively a content of consciousness which includes what we have called discrete coexistence (or side-by-sideness) of sensations of touch, sight, hearing, smell, and so on; and we will begin by considering the different kinds of sensation, one by one. As regards tactile sensations (in the widest sense) the words "discrete coexistence" express literally the data of sensation. If I touch the tip of my forefinger with a compass, of which the two points are five millimetres apart, the double impression is absolutely coexistent. If I proceed to touch my finger-tip with one point and my palm with the other there is still coexistence, but different in nature and wider apart; and the same happens with all simultaneous sensations from the crown of my head to the soles of my feet. And thus, while all simultaneous cutaneous sensations unite in a side-by-sideness which we feel as being the surface of our bodies, similarly our subcutaneous, tactile sensations, that is the inner, deeper ones, accompany and repeat their coexistence in other directions from outside inwards, and this series is added to the previous one, whereby the various sensations of our organs, and of posture, and movement, are constituted. And all, cutaneous and subcutaneous alike, whatever their nature, are directly referred to their respective bodily places.[1]

[1] In current speech we are wont to say of outer and inner tactile sensations that they are "felt"—an expression which uncon-

I would here note in passing that sensations of taste approximate most to the outer and inner tactile sensations.

I refer the reader to what has already been said on this subject in the foregoing chapter, and now wish only to emphasize the point that in sensations of taste the relation between them and the subject, or rather the part of his bodily surface affected, namely, the tongue, begins to assume minor importance.

The same is the case to a much greater extent even in smell, where, as we saw, there is hardly any such reference of the sensation to the implicated bodily surface.

Turning now to sensations of sight and hearing, I need only repeat the remark already made in the previous chapter (page 80), that they reveal a side-by-sideness of sensation corresponding to the stimulation of the nerve, but that the direct consciousness of a particular part of the body being affected does not occur. I have there, and in the following pages, given a fuller explanation of this, with special reference to the organ of sight, and may sum up my conclusions as follows: "We have two objects, A and B. When we see an object, A, in a particular relation to an object, B, say on the latter's right, then the particular relation of their coexistence undoubtedly corresponds to a particular relation between the gates of stimulation; *but we are not aware of this relation as such.*"

As a general fact, we are not, when seeing an object, aware that a part of our eyes, the retina, is involved; we only infer it. We have already shown that the same thing occurs in sensations of hearing, only here a very

sciously implies the idea of a closer connection between such sensations and the ego than when we say, "I see, hear, or smell." Many writers, therefore, count these sensations among the feelings which are defined as being dependent not on anything objective and opposed to the sentient ego but on that ego or subject itself. We cannot accept this definition, for we describe as "feelings" only the qualities of pleasure or pain which accompany sensation, and whatever may be derived from such accompanying pleasure or pain.

important difference arises. Discrete coexistence in optical sensations is closely related from the outset to coexistence in tactile sensations (taking this in the widest sense) and especially to sensations of bodily position and movements of eye and head. Apart from sensations of ocular movement (which belong to the category of tactile sensations) we are not aware while seeing any object that our bodies, and more particularly our eyes, are perceiving stimulations, or, as I have expressed it, are *gates of stimulation*; nevertheless, not only is the body participant in the seeing of an object, but we are constantly making the experience that its position determines that of the whole visual side-by-sideness. Here is the bridge connecting the discrete coexistence of our visual and tactile sensations; this is how our visual and our tactile spaces combine together.

There is no need to consider here how far this community of perception may be due to inheritance or to individual experience. A chick which, on quitting the egg, aims and pecks at a grain on the ground with comparative accuracy, manifests in this respect, just as in the morphological development of its central organs, a far higher point of evolution at birth than does the human infant which continues to snatch at objects a double arm's-length off even when it is four or five months old.[1] But to draw from this the conclusion that human beings acquire the correlation of the side-by-sideness of visual, and the side-by-sideness of tactile, sensations entirely and exclusively from separate individual experience seems to me exaggerated, however undeniable it may be that the systematic establishment of such relations is brought about in man only by individual experience, that is to say, by the associations presiding over the garnering-in of the individual store of engrams.

But we are not here concerned to decide the controversy between natalists and empiricists; our task is to establish the fact that the connection between the side-by-sideness of visual, and the side-by-sideness of tactile,

[1] Cf. W. Preyer, *Die Seele des Kindes*, 5 Aufl., 1900, S. 32.

sensations, where not already established at birth as in the case of the chick, becomes at last fully established in the normal infant, just as it is by the congenitally blind man when sight is given him by a surgical operation.

The case is very different with sensations of sound, which share with visual sensations the peculiarity that stimulations are not perceived in any particular part of the body. Just as little as, except where there is pain, we "feel" that a particular part of our eyes is involved in seeing so do we fail to "feel" sound in any special portion of our ears, except when sound produces pain or when the vibration of the air causes tactile sensations in the skin of the ear or its drum. So far, therefore, auditive and visual sensations agree; and the likeness extends to another important point; for in the side-by-sideness of sounds there exist the same definite relations among separate components as in the similar side-by-sideness of tactile and visual sensations. But the side-by-sideness of sound-sensations is limited in one direction, their juxtaposition being felt as altogether linear, whereas the juxtaposition of tactile and visual sensations in all directions is in the first instance one-dimensional, but can be followed out in three dimensions or stereometrically. This subject will be resumed farther on.

The speech of nearly all nations[1] expresses the fact that the side-by-sideness and, what amounts to the same, the sequence of sound-sensations is linear and constitutes what is called a scale. And we feel this order not only when we hear the sounds consecutively (which might be considered a function of time) but we are conscious of it equally when the linear or one-dimensional nature of the side-by-sideness is clearly perceived.[2]

[1] See the interesting remarks of C. Stumpf, *Tonpsychologie*, 1 Bd., 1893, S. 192–9.

[2] The real establishment of relationships, that is to say, the comparison between tones even when they are successive, is itself (as we shall see in the seventeenth chapter) a simultaneous occurrence, that is to say, this comparison refers to a side-by-sideness. Consequently we may learn something in this respect from the auditive vocabulary of people like the ancient Greeks and Romans,

I would now elucidate my argument by the following remarks.

Since one always feels the components of coexistent sounds as a sequence, and divides them therein into lowest, low, middle, high, highest, with intermediate gradations (or, to speak like the Greeks and Romans, into heavy, heaviest, sharp, sharpest), I conclude from observation of myself that the sensation of coexistence here, just as in touch and sight, is not to be regarded, as is so cautiously done by many psychologists, as a case of unrelated simultaneousness, but as a connected side-by-sideness, with the difference only that in sound, contrariwise to touch and sight, the order is one-dimensional or linear. Our mode of speech therefore expresses a fundamental element of the relations between our sensations of sound; it does not express anything of a figurative nature, nor is it borrowed from other spheres of sensation, nor yet a piece of space-symbolism.[1]

So far Mach. I would, however, allow myself a marginal note to the effect that language would far better express the position of sensations in their relation to the coexistence (side-by-sideness) of sounds if it took no account of the direction which is determined by bodily posture. For, as I have said in the text, the direction

or the present Chinese, East Indians, Arabs, Turks, and modern Greeks, who, when uninfluenced by Western examples, cultivate only one part of music instead of the polyphonic sort.

[1] A similar idea, of course in another connection and different significance, is to be found in Mach's *Analyse der Empfindungen*, 4 Aufl., 1903, S. 217, where it is said: "A sequence of sounds may be regarded as an analogue of space—a space of one dimension marked off on both sides and possessing little symmetry, something like a straight line running right and left perpendicularly to the median plane. Or, again, it is analogous to a vertical straight line or to one which in the median plane runs from before behind.

"That the sphere of sound-sensations offers an analogy to space and especially to unsymmetrical space is a fact which has found expression in speech. We speak of high and low tones, not of right or left ones, although our musical instruments do approximate to the latter description."

of a sound-sequence is quite independent of that given by the position of the body. Mach is quite right in affirming that the sequence of sound-sensations is not symmetrical to anything in ordinary space, but in fact as regards ordinary space it possesses no " direction " at all. This, however, is not the case if we give to the words " high," " low," " above," " below," a meaning referring to a definite position and direction of our body, taken from head to foot. For the side-by-sideness of sound-sensations has no relation to the position of the body, nor to the side-by-sideness of tactile and visual sensations ; it is felt as lacking any direction in this sense. The terms " high " and " low " found among so many different peoples are probably associative metaphors. The spatial location of vocal production is metaphorically transferred to the sounds thus produced.

The tones which we seem to ourselves to produce from the lowest part of our chests we describe as deepest in themselves, and reckon them as belonging to the " chest register," while others seeming to come from higher in the throat are called " high notes," and talked of as belonging to the head system. As already remarked, the Greeks and Romans did not speak of low and high, but of heavy and sharp, notes, deriving their comparisons, therefore, from quite another source. For the rest, the Greeks and Romans also distinguished between an upper and lower relation of sounds.

I repeat that the use of the words " over," " under," " high," " low," applied to the side-by-sideness of sound does not correspond to any really perceived relationship between sequences of sound and positions of the body, that is to the side-by-sideness of sensations of posture and sight, but is derived from the association of particular sensations of sound with the apparent place of their production (chest or throat). Setting metaphor aside and in reality there is no link between the coexistence of sensations of sound and coexistence of tactile and visual sensations, and consequently no connection between the former and the position of the body.

In sensations of sight also we have no feeling of the stimulation of a particular part of the body. But in this case what we do feel, that coexistence (side-by-sideness) of sensations of sight which we describe succinctly as the "field of vision," does always depend upon the position of the body or, rather, of the eyes. On this basis there has gradually built itself up a generalized space-representation containing both the side-by-sideness of tactile sensations (tactile space) and the side-by-sideness of visual sensations (visual space), and this is what is called in everyday parlance "space," but which I propose to call "common (or composite) space."

There is no similar relation between the side-by-sideness of sound-sensations and that of tactile and visual ones; but this assertion only applies to the side-by-sideness of sound sensations determined by the pitch of their components and not to sound-sensations in themselves. There are other relations in which these are connected with our sensations of bodily position. This connection is manifest in the sensation of the direction whence sound proceeds, which has in itself no direct relation to the side-by-sideness of tone-sensations. In the next chapter we shall examine more particularly the fact that the direction whence a sound comes is conveyed to us by our distinguishing between stimulation of the right and of the left ear, so that in this case there is clearly a direct relation between sensations of sound and sensations of bodily position (i.e. position of the ear), and consequently between sensations of sound and of a common space. But this arises merely through the united action of the two ears and the different intensity of the excitations produced. The position of the organ in space has no influence on the side-by-sideness of tones—on, that is, our perception of their relative pitch. We feel the side-by-sideness of different pitches whether we are upright, recumbent, or so bending down that our skull touches the ground, and this is the real reason why we cannot feel the side-by-sideness of tones in any settled and direct relation (as distinguished from a

metaphorical one) to common, i.e. composite tactile and visual, space.

Side-by-sideness, therefore, exists in sound-sensations as much as in visual sensations, only being unconnected with "common" space it is isolated; it dwells, so to speak, in a separate region. This separate region might be described as tone-space, if misunderstandings might not easily arise from such an expression, which I, therefore, reject for the following reasons. We have no primary immediate datum of either tactile or visual space, nor of a combination of the two. This side-by-sideness of tactile and visual sensations has afforded the basis on which, phylogenetically and ontogenetically—that is partly as an inheritance, partly as an acquisition of each individual experience—there has built itself up what we mean by our representation of space.

A conceptual building-up (*aufbau und weiterbau*), corresponding to the one we have just spoken of, has been rendered impossible by that already-mentioned isolation of the sphere in which auditive side-by-sideness exists. In this case development through manifold combinations such as we can point to in the side-by-sideness of tactile and visual sensations has not taken place, and all that we have is a simple, a peculiarly simple, a linear side-by-sideness.

For this reason it would be illegitimate to speak of "spatial representations" with regard to the side-by-sideness of tone-sensations. All we can say is that such side-by-sideness of tone-sensations does not rest upon the same assumptions, but only approximates to the peculiar qualities which have allowed us in the sphere of tactile and visual sensations to formulate a notion of space.

Leaving general considerations we come to practical results, as follows: The side-by-sideness of sensations of touch, taste, sight, and tone is to be understood as literal and not as a mere simultaneousness. To describe it as a side-by-sideness in space would indeed be of help in clearing up the subject for those who are not fully conversant with it; but we must always remember

that such side-by-sideness of sensations is the primary factor and more universal than the conceptions of space, which we derive from the special combination of such side-by-sideness in tactile and visual sensations. This being premised, we may hope not to be misunderstood when, having to handle the side-by-sideness of sensations in all sensorial spheres together and to analyse them from the same standpoint, we borrow the necessary term from the vocabulary of our representations of space. I adopt the expression "field of sensation," and shall proceed to describe, for instance, the particular components of the side-by-sideness of tactile sensations as being found in corresponding fields of sensations of touch. The fields of sensation of taste are combined with particular fields of tactile sensation owing to the fact that the gates of stimulation for touch and taste are distributed between the tongue and palate, and thus share between them the same region.

And we shall speak in the same manner of the visual field of sensation. This has long been the usual term for the totality of all the various fields of vision, and we shall continue to employ it. The fields of visual sensations have points of contact with those of tactile sensations, while the fields of auditive sensation are quite cut off from the other two, and have their only link with these in the feeling of the direction whence sound comes. And this is only realisable through the joint action of both organs of hearing, and offers no possibility of bringing the side-by-sideness of fields of auditive sensation under the same orientation with the discrete coexistence of the other fields of sensation. We shall return later to the field of sensations of smell. Applying now the phraseology we have chosen to a closer definition of the different kinds of side-by-sideness as we feel them directly and have already described them, we may say that we feel the various fields of cutaneous sensation as appertaining to a surface, this being especially evident when touch is unaccompanied by any sensation of movement. Through addition of the latter, through the combination of outer

with inner sensations of touch, the tactile sensations acquire depth add spatial order.

Mach makes a similar observation to this when explaining the difference between physiological and metric space. "Skin-space", he says, "corresponds to the bi-dimensional, finite, enclosed space of Riemann, while sensations of movement in the limbs, especially the arms, hands, and fingers, furnish us with something corresponding to a third dimension." [1]

Much the same can be said of sensations reaching us not through the outer skin, but through the retina. The fields of sensation of each separately are primarily superficial or two-dimensional; it is only the combined action of both eyes joined to tactile sensations (and these come to the help of the one-eyed) which enable us to see things in relief.

The fields of sensation of hearing are separate from those of touch and sight. They form one simple linear series which, as already explained, has no relation to the direction of tactile or visual fields of sense.

A matter of fundamental importance is the strict connection between the order or arrangement of all fields of sensation and the topography of the gates of stimulation.

In the foregoing chapter (pp. 57–70) we studied the general features of the relation between the side-by-sideness of sensations and the locality of the gates of stimulation, and we have now to examine the subject in greater detail.

If we find that the arrangement of fields of sensation and of the side-by-sideness of touch and sight is that of a plane, we also find on close investigation of their topography that a similar arrangement holds good for the gates of stimulation through which these sensations manifest themselves.

If, on the other hand, the arrangement of the fields of sensation is linear, then so is that of the gates of stimulation when similarly examined. Further, as already explained, when the discrete coexistence (side-by-sideness)

[1] E. Mach, *Erkenntnis und Irrthum*, 1 Aufl., 1905, S. 334.

of sound-sensations is clearly linear, then in my view we should confidently conclude that there is a similar arrangement of their gates of stimulation; and this conclusion would agree with the idea, based on Helmholtz's theory of resonance, which we may form of the relation between the sensation of pitch and nerve-excitation. As already said, Helmholtz's contentions are much disputed, but even admitting the physical objections urged against contemporaneous vibrations of the small fibres or strings of the basilar membrane, especially in the case of very deep tones, the fact remains that most investigators agree as to the necessity of some physiological theory of resonance. But when the utmost meaning is extracted from this rather unsatisfactory term, all that the "physiological theory of resonance" amounts to is that to a series of sensations of tones of different pitch there corresponds a series of particular gates of stimulation. The physiological theory of resonance borrows from Helmholtz the determination of pitch by the locality of stimulation—the particular terminal nerve affected—but it leaves undecided the question whether stimulation at such a point follows from the contemporaneous physical vibration of the basilar membrane's fibres or from some other cause.

In the passage quoted,[1] Mach remarks that the series of sounds exists in something analogous to space and, moreover, to space along a sort of straight line. He is right in saying "a sort of straight line," for, although we feel the single or linear arrangement of tone series, we have no definite feeling of their quality in other respects, neither of their course nor whether they are straight or crooked, even or uneven. That we should represent them to ourselves graphically as straight is quite comprehensible, for in such a representation we are obliged to attribute a definite shape to them, and we select the straight line as the simplest and most convenient in the absence of any other furnished by sensation. Introspective examination of a tone-series

[1] P. 91 n.

shows us that all we experience is the one-sided, the *linear* quality, and we are unable to say whether the line is straight or crooked or spiral. Instead of straight we might equally well figure it to ourselves as spiral, somewhat resembling the terminal nerve-cells of hearing (the hair cells) which inside the organ of Corti form a spiral band about one millimetre in width. But here I have simply to state the fact that our consciousness possesses no definite image of a tone-series, and we can only characterize it as linear.

FOURTH CHAPTER

FIELDS OF SENSATION
(continued)

IN continuation of the results arrived at in the preceding chapter we have now to examine the nature of the different coexistences in the several fields of sensation together with their relation to the gates of stimulation.

1. TACTILE SENSATIONS.—We experience the components of a side-by-sideness to be mutually related in a manner corresponding with the gates of stimulation. Moreover, each component in addition to its specific quality of sensation is also always accompanied by the special awareness that a particular part of the body is undergoing stimulation.

2. VISUAL SENSATIONS.—Here again the components of a side-by-sideness are in a relation to one another which corresponds to the position of the gates of stimulation. But as a rule the particular sensational element showing the affected portion of the body is wanting. Nevertheless, the relation between the gates of stimulation and side-by-sideness in sight is sharply defined; and with the addition to the latter of co-existent tactile sensations a common image of space comes into being.

3. SENSATIONS OF SOUND.—Again there is correspondence between the components of a side-by-sideness and the position of the gates of stimulation, but, as with sight, there is lacking the special element of sensation which tells of a particular part of the body being stimulated. The relation between side-by-sideness, so far as it goes, and the different gates of stimulation reduces itself to a linear arrangement of sensation. There is no awareness

either of the shape of this line, whether straight or spiral, or of its direction. And there are no connecting links between side-by-sideness of sound-sensations, or pitch, and side-by-sideness of tactile and visual sensations.

4. OLFACTORY SENSATIONS.—One cannot speak of side-by-sideness of sensations in regard to smell. It is true that we distinguish certain peculiarities which remind us of one scent or of another, but there is no simultaneous, clear side-by-sideness of different components. When we analyse complicated mixtures of smells we do so successively not simultaneously, for, as Valentin[1] and Aronsohn[2] remark, first one scent and then the other gains the upper hand.

I conclude therefore that sensations of smell (when not overlapping with those of taste and, occasionally, of touch) are each confined to one particular field; and are in so far independent of other senses.

We must, however, qualify this statement by pointing out that the overlapping between sensations of smell and taste is only present when olfactory sensations result from breathing-in (or inhalation).

The case is different when these sensations follow on breathing-out (or exhalation), as in the act of swallowing when the scent or fragrance of food comes from the gullet. This out-breathed (or exhaled) scent, is well known as gustatory smelling, and its sensations combine so closely with those of taste and touch that they seem to belong to the region of the latter. Only in-breathed smells are as independent of all other fields of sensation as are sensations of sound. Although there are circumstances, as with stinging smells and when there is active "snuffling," which makes us aware of the passage of air along the uneven inner surfaces of the nostrils, wherein an overlapping of sensations of smell and touch does occur. For the rest we can tell pretty nearly when

[1] Valentin, *Lehrbuch der Physiologie*, 2 Aufl., 2 Bd., 1848, 2 Abt., S. 292.

[2] Aronsohn, *Experimentelle Untersuchungen zur Psychologie des Geruchs, Archiv Anat. u. Phys.*, 1886, S. 321.

smell follows on exhaling from the gullet or on inhaling through the nose. We do not often ascribe to something which we are eating a smell which reaches us from outside. In cases where the gustatory smell in the sensorial field of taste and the smell consequent on breathing-in (or inhaling) in the field peculiar to that sensation can be distinguished from one another, there is, perhaps, a real side-by-sideness of the two sensations, but it is difficult to test this simultaneousness and to eliminate the possibility of a rapid oscillation of attention between the one and the other. The decision of this point must be left to further research.

Having taken stock of the example of what we have called "side-by-sideness" in the various fields of sensation, with regard both to their nature and their relation to the "gates of stimulation," the reader will understand why we reject Lotze's well-known and, from a practical standpoint, usable term "*local signs*." Lotze[1] carefully defines the term as follows: "As the localization of an elementary sensation is spatially independent of its particular quality so that at various moments quite different sensations occur in the same portion of our visual representations of space, every excitation must borrow its peculiar character from the special point of the nervous system in which it takes place, and to this character we give the name of 'local sign.'"

It will be observed that in this definition Lotze starts not from the side-by-sideness of sensations but from our visual image of space, and this, as we have seen, is itself based entirely upon the data supplied by the side-by-sideness of tactile and visual sensations. Auditive sensations have no share in this "space"; they are excluded from it, and consequently the term "local signs" is strictly inapplicable to them. Now it so happens that there is considerable analogy between the essential characteristics of their side-by-sideness and the sensations of sight. What the two lack in common is the consciousness or, as we might say, the supplementary sensation that

[1] H. Lotze, *Medizinische Psychologie*, Leipzig, 1852, S. 331.

a particular part of the body is stimulated; consequently they have, strictly speaking, no "local sign"; moreover, in both the spheres of sense in question, the components of a side-by-sideness are felt to have only the particular reciprocal relation which corresponds to the arrangement of the gates of stimulation. If we describe these peculiarities as "local signs" accompanying the separate elements of side-by-sideness, then we must attribute such local signs as much to sensations of sound as to those of sight. If this were the case the quality of sound-sensations which we call *pitch* would cover, would be identical with, the "local signs"; and that would, to some extent, contradict Lotze's definition as above given.[1]

I reject the definition for all these reasons, and for others also which I do not give here as they cannot be grasped without a further acquaintance with the contents of this volume. For our purposes the notion of "fields of sensation" suffice to represent the side-by-sideness of sensations and to express the law of its continuity.

My conception of "feelings" as particular qualities or shades of sensations implies the position of these feelings towards the different fields of sensation. If pleasure or pain be associated with the sight of a particular colour, or the hearing of a particular sound, then the feeling in question is not merely attached to the sensation but is part and parcel of it; that is to say the feeling and the sensation exist in the same field.

It would be a highly interesting and not very difficult undertaking to show that these so-called "common feelings" fall quite naturally into our categories, but I cannot enter upon this subject here. Even an explanation of the relation towards the various "fields of sensation" of such abstractions as are derived from our sensations and feelings, showing how such composite and synchronous

[1] Lotze's own remarks, *ibid.*, p. 332, show that he did not clearly see that the mere side-by-sideness in *pitch* is the only criterion for the use of the word "local sign" in the case of auditive sensations.

data of consciousness belong to precisely as many " fields of sensation " as the single sensory elements of which they are composed—even such a demonstration, though fairly easy of proof, would take us too far from our special theme.

Preferring as we do to confine ourselves to fundamentals, it is enough to show that the side-by-sideness of all original sensations together with their shades (or *nuances*) seem to fall into fields which we have described sufficiently, and that, as the second part of this work will show, all corresponding mnemic sensations with their varieties are placeable in exactly the same fields, and in exactly similar relations to one another and to the original sensations.

In concluding these remarks on fields of sensations, I would briefly mention two special possibilities which, although very important in themselves, are for us of only secondary significance, but which for the sake of completeness deserve at least to be mentioned, besides being in themselves interesting inasmuch as falling into line with very important phenomena which we shall have to handle in the following chapter.

These two questions are :

1. How are we affected by two (or more) sensations occurring in the same field ?

2. Does a sensation in one field act specifically on sensations in the neighbouring fields ?

In reply to the first we must clearly understand the conditions under which two sensations of different quality make themselves felt in the same field. As a result of our previous researches we can immediately say : " The junction of two dissimilar sensations in the same field always occurs when the two stimulations from which the sensations result enter through two gates of stimulation topographically close together. Thus, in the sphere of skin-sensations, we perceive contact, temperature, and pain, whose sensory localities are juxtaposed as belonging to the same field of sensation ; we perceive them, e.g. as cool or warm contact, again as painful pressure in a

definite part of the body. Here we verify the only result which we have been led to expect from such a coincidence, namely the close union of two sensations together with the persistence of the characteristic qualities of each component.

In other spheres of sense than those mentioned above and under exactly the same conditions a new combination may arise which bears no resemblance to the quality of its components. Such combinations result especially in the sphere of smell.

Extraordinarily instructive, because capable of being most closely investigated, and highly significant practically is the presence of two conjoined sensations in the sphere of sight. There are various ways of provoking stimulation so as to bring the consequent sensations into the same field. One is to elicit the various stimulations through locally insufficiently separate, closely contiguous gates of stimulation. This method is employed, for instance, in " pointillist " painting.

Another mode is to apply different stimuli to the same point of the retina at such brief intervals that one sensation has not quite died away when another in the same field of sensation comes into play. In this case sensations arise in the same field when one eye only is engaged, but the same result can be obtained by using both eyes, only then the simultaneous excitation is caused, not by stimulation of two contiguous points nor by a rapid change of stimuli applied to the same retina, but by the stimulation of *corresponding* spots in the right and left eye. Such corresponding spots—less happily described as " identical " —in the retina may be defined as *gates of stimulation for excitations which manifest themselves as sensations in the same sensorial field.*[1] Every point in the retina of one

[1] We might apply the same definition to the organ of hearing. Every gate of stimulation in the right ear corresponds to one in the left, so that sensation has a similar place in the side-by-sideness, occupies the same field, and possesses the same pitch. But since in the ear, in contradistinction to the eye (and all other organs of sense), one gate of stimulation can produce but one kind of

eye corresponds to a point in the retina of the other eye. If in corresponding places in both eyes different stimuli are employed in such a way that the sensorial manifestations appear in the same field we shall find that the combination has great but not absolute similarity with what results from alternate stimulation of the same place in one eye, or, in other words, that the sensations are similar but not completely similar to those resulting from a combination of an acoluthic with a synchronous stimulation in the same field (cf. the invalidity of Talbot's law in the binocular mixture of colours). In a considerable number of cases, however, no combination of different sensations in one field arises but the alternate production first of one and then of the other, a phenomenon known as " competition." I have already pointed out that with regard to sensations of smell these do not manifest themselves in a side-by-sideness, and consequently that unless they get entangled in the sensorial field of taste or touch, sensations of smell appear in one single field of sensation.

Despite the degeneracy of the human organ of smell the surface of the nasal mucous membrane, the *regio olfactoria*, forms a sufficiently extensive tract extending over the upper shell (*muschel*), the upper nasal passage, and the median plane of the middle shell, as well as over the corresponding horizontal, of the *septum narium*. In older individuals it is mostly confined, it is true, to the upper half of this tract.

It is therefore an interesting fact that a difference in the olfactory sensation cannot be noticed, whether it enters by the right or the left organ, nor whether a larger or smaller portion of this be the gate of stimulation.

The only exception to this rule is the fact mentioned at page 101, namely that we can distinguish between

sensation, and all corresponding gates must consequently be regarded as one, it is useless to discuss the impossible presence of different qualities of sensation in one and the same field.

In the following chapter we shall have to consider the production of two similar or nearly similar sensations produced by a di-otic stimulation.

"breathed-in" and "breathed-out" smells. Further research must decide whether this difference is attributable to an accumulation of individual experience or to a direct localization of olfactory sensation. What concerns us at present is that the facts lead to the conclusion that there is no demonstrable connection between the quality of olfactory sensations and the minute topography of the portion of the *regio olfactoria* in which they are produced.[1]

This is further confirmed by the fact that if different stimuli be applied to the right and left nostril the consequent sensation is not a double coexistent one, but either there is a new specific sensation,[2] or two consecutive sensations arise and compete for mastery (as in the competition in optical fields) or, finally, there is a reciprocal weakening which may lead to full compensation on both sides.

Zwaardemaker,[3] for instance, found that the odour of indiarubber applied in sufficient amount to one nostril overpowered the smell of paraffin or wax or balm of tolu in the other. First one smell and then the other predominated when the stimuli were differently proportioned, but when they were in the end correctly administered there ceased to be any smell at all. The same result was obtained when very strong stimuli were employed,

[1] This is not contradicted by experiences resulting partly from fatigue, partly from a partial defect in the olfactory organ, and the consequent inference that for different kinds of olfactory stimuli there may be different perceptive organs (as is the case with the organs of taste but, unlike the latter, only to be indirectly postulated). Nagel (*Handbuch der Physiol. des Menschen*, 3 Bd., S. 611) justly remarks as to further hypothetical conclusions that "Zwaardemaker's attempt to classify olfactory constituents into nine perpendicular rows from front to back, corresponding to nine classes of smell, and for each row from above below to postulate as probable a graded scale, can only be regarded as fantastic, the more so that there are no grounds for believing that olfactory elements of different specific energy constitute separate series in space."

[2] *Vide supra*, p. 84.

[3] Zwaardemaker, *Physiologie des Geruchs*, Leipzig, 1895, S. 170.

as, for instance, 2 per cent. acetic acid, and 1 per cent. ammonia applied simultaneously. For further compensatory effects see Zwaardemaker.[1]

The state of affairs with sensations of taste apparently resembles that of smell; but the nature of the gustatory organ prevents that total separation of sensations which takes place in the quite differently constituted olfactory apparatus. We showed on page 79 that if we provoke two sensations of taste separately by applying stimuli to two separate parts of the tongue, the sensations are felt as existing in two separate fields. Therefore the different stimuli must be made to act simultaneously on the *same* part of the tongue. On the contrary, olfactory sensations which appear as existing in one and the same field can be produced in different parts of the *regio olfactoria*, that is, through the right and left nostril; a fact which is of great advantage for the experiments with which we are dealing.

In the case of applying different stimuli simultaneously to the whole tongue, as a rule there is competition among the various resulting sensations, particularly those of which the stimuli are strong, first one sensation and then the other being predominant. On the other hand, Brücke[2] pointed out the possibility of reciprocal weakening in the stimuli; and Kiesow[3] showed that a mixture of sugar and table salt in certain proportions yields a very slight insipid taste which is reminiscent neither of sweet nor salt. As in this case the sensation is of a specific novel kind we cannot correctly speak of compensation, but this novel sensation is so weak that it offers a certain analogy with the much more decided experimental results obtained by compensation in olfactory sensation.

We now come to the second question raised, the relation, that is, between the closer or less close neighbourhood of the fields of sensation in which two sensations arise, and the manner in which these sensations present them-

[1] *Ibid.*, pp. 165–74, 283.

[2] Brücke, *Vorlesungen über Physiologie*, 1885, Bd. II, S. 265.

[3] Kiesow, *Philosophische Studien*, 12, 1896.

selves. We will start with a case—to be further handled in the next chapter when treating of sensations in *the same field*—the case, that is, of two sensations *in different fields* being of the same specific quality. When under these circumstances the fields are contiguous the sensations are continually merged. It is true that in a symmetrical spot of colour or an equal pressure on our skin we distinguish the upper from the under side, the right from the left, but the whole impression constitutes a unity to a much greater degree than if sensations of differing quality arose in these absolutely contiguous fields.

Against the general assumption here made it may be objected that it does not apply to sensations of sound. C sharp, D sharp, and E struck simultaneously would not in the least produce an impression of greater side-by-sideness than, say, C, E, G, C′. To this we reply in the first place that, even for a very unmusical ear, the semitones of the interval C sharp, D sharp, E do not seem to lie in contiguous fields of sensation. Contiguity can only be postulated for fields of sensation when sensations (especially in successive experiments) manifest themselves as just perceptibly different; and consequently, in order to achieve the same result of stimulation as yields a unified and extensive continuity of sensation in touch or sight, one would require in a series of tones a simultaneous stimulus composed of tonal intervals not $\frac{1}{2}$ but $\frac{1}{200}$ apart.

Such experiments to my knowledge have never been made, and neither from my own nor from others' experience can I say whether or not a simultaneous stimulation set up by a series of sounds in really contiguous fields would produce a much more continuous series of sensations than the simultaneous stimulation provoked by the ordinary tones of an organ or piano.

Such an experiment—requiring of course, a big *ad hoc* instrument [1]—would be indeed interesting to make, as

[1] Taking Preyer's experiments (*Grenzen der Tonwahrnehmung*, 1876), it would seem that within the same octave, h^1—h^2, there are not 12 but, on an average, 1,200 uniformly different gradations of tone.

it would establish the possibility of a totally new kind of tone-sensation. For the successive passage from a tone to its higher or lower neighbours is of course an essentially different thing; and the simultaneous stimulus provoked by unison in a chorus or an orchestra, where, naturally, many of the voices are either above or under the correct pitch, would at worst result in a continuity of semi-tones (described as a whole of "impure" tones) but would not bridge over wide discrepancies.

Despite the possibility that such experiments might reveal a certain continuity in the simultaneous awareness of a row of tones, it is yet clear that in one respect there would be an essential difference from other spheres of sensation. In the sphere of sound the quality of sensation produced varies regularly to a far greater degree with the distance in locality of the gates of stimulation than happens in other spheres of sense, for instance in visual or tactile sensations.

In the sphere of sound it is not possible to produce the same quality of sensation in different fields as it is in other senses. Obviously the cause of this lies in the particular mode of functioning of this sense-organ, characterized as it is by an automatic selection of stimuli at the very gates of stimulation.

An acoustic stimulus is not active at, say, gate K as well as at gate T, as would be the case with the organs of sight, taste, or touch; one specific stimulus only can enter at gate K, while gate T alone admits some other specific stimulus.

Let us now turn to the phenomena of different sensations in neighbouring fields. Especially in visual sensations a strong reciprocal influence is apparent.

The experimental fact that when a visual sensation arises in one field antagonistic sensations (in Hering's sense) assert themselves in contiguous fields may be taken as an example of such reciprocal influence. When yellow appears in one field, the contiguous fields appear blue; a red colour has green for its complement; against darkness in one field, light appears in its neighbour, and

vice versa. This phenomenon of a reciprocal simultaneous induction is usually described as simultaneous contrast; and E. Mach [1] and, later, in a wider sense, E. Hering [2] have shown that if we regard this phenomenon from the side of excitation, all its accompanying manifestations become explicable by the hypothesis that between the various contiguous excitations [3] of a particular portion of the optic substance there is such interdependence that a luminous excitation in one portion of that substance sets up reverse stimulation in neighbouring parts, and of course strongest in the fields nearest to one another and gradually less as distance increases.

We need not enter here into detailed proofs of this fact, nor dwell on the great importance of the part played by simultaneous contrast in the completeness of our sight. Interesting facts regarding simultaneous contrast in other regions of sense, such as movement, taste, touch and especially temperature, have been recently collected by A. V. Tschermak.[4]

The induced effect of excitation upon surrounding sensitive substance of the same specification is best seen in sensations of sight and temperature, as there we can tick off the results of reciprocal influences and note how

[1] E. Mach, "Ueber die physiol. Wirkung räumlich verteilter Lichtreize," *Sitzungsber. d. Wiener Akad. d. Wissenschaft*, Bd. 52, 1865; Bd. 54, 1866; Bd. 57, 1868; Bd. 115, 1906.

[2] E. Hering, *Zur Lehre vom Lichtsinne*, Wien, 1878. *Ueber die Theorie des simultanen Kontrastes usw., Plüger's Archiv*, Bd. 40, 41, 43. *Grundzüge der Lehre vom Lichtsinn*, "Graefe-Saemisch, Handb. der Augenheilkunde," 2 Aufl. (115 Lieferung), 1907.

[3] With Hering I describe as "optical substance" the irritable substance of the organ of sight in all its parts from retina and connecting nerves to those portions of the central nervous system which specially perform optic functions. J. Müller uses the term "sense of sight-substance." The contrasting effects consequent on optical excitations are certainly not confined to the peripheral section of the optic substance. In this connection reference should be made especially to the interesting facts of binocular contrasts, although simultaneous and successive contrasts are essentially uniocular and independent of the other half of the optic apparatus.

[4] A. V. Tschermak, *Über simultankontrast auf Verschiedenen Sinnesgebieten*, Pflüger's Archiv, Bd. 122, 1908.

this diminishes with increase of distance. As contiguity lessens, the effect becomes less and less till it finally vanishes altogether.

The views of V. Urbantschitsch,[1] that all simultaneous sensations possess a reciprocal influence, strong beyond all expectation, and which (setting aside the so-called narrow focus of consciousness) include not only intensity but quality, seem to me not to be accepted as facts, because they have not been investigated by methods excluding the possibility of auto-suggestion and alien suggestion by others upon the subject of the experiments. We require, at least, more accurate observations upon the constancy of different results furnished by repeated experiments on the same person at various times.

We can, however, accept as established facts the reciprocal influence of sensations of light and colour, differing among themselves, as well as temperature-sensations (also differing) lying in contiguous fields of sensation. In the sphere of sight Hering has convincingly shown that the observed manifestations of sensation lead us to infer a definite reciprocal influence among corresponding excitations of the optical substance.

[1] V. Urbantschitsch, *Über den Einfluss einer Sinneserregung auf die übrigen Sinnesempfindungen*, Pflüger's Archiv, 42 Bd., 1888. The later researches of this writer in the same field concern rather the influencing of mnemic sensations through primary sensations of a different quality. See Pflüger's Archiv, Bd. 94, 1903, and later.

FIFTH CHAPTER

SIMILAR SENSATIONS IN THE SAME FIELD OF SENSATION. HOMOPHONY AND DIFFERENTIALS IN ORIGINAL SENSATIONS

WHAT I call homophony (absolute equivalence or similarity of sensations) exists whenever in the same "field of sensation" sensations arise which cannot be directly distinguished from one another either by simultaneous or by successive comparison;[1] again, if we are dealing with groups (complexes) of sensations, homophony exists when these arise in correspondingly combined fields of sensation. For the sake of simplicity I shall usually speak only of "sensations," but this is to be understood as including complexes as well as single sensations.

In the present chapter I shall discuss only the homophony of original sensations and begin by asking, What are the conditions for the presence in the same field of several original sensations indistinguishable by direct comparison? The general answer to this question is easily formulated as thus: "Whenever sensations are excited by similar stimuli at corresponding gates of stimulation."

We have got to know corresponding gates of stimulation in the corresponding retinal parts of the right and left eye. If these are subjected to similar stimuli and the direct reaction of consciousness alone taken into account, the effect produced is not recognisably different from what it would be if the right or the left eye alone were stimulated. The following simple experi-

[1] Into the comparison of sensations I shall go more closely at the end of the seventeenth chapter.

ment will make this clear. Stick two similar stamps, say two red penny, or two green halfpenny, ones 55 mm. apart upon a sheet of paper and look at them through a stereoscope. Assuming the sight of both eyes to be the same and the lighting adequate, no difference will be perceived whether one looks first with one eye, then with the other, or with both at once. In this experiment corresponding places are exposed to similar stimuli; alternate, where first one, then the other, eye is engaged; simultaneous, where both eyes are used. We shall, later, analyse more closely the result of the last-named stimulation; all we now need to establish is the presence in it of conditions necessary for the junction of two indistinguishable complexes of sensation in the same field.

A similar experiment can be made by the simultaneous stimulation of corresponding places (that is, gates of stimulation for equal pitches of tone) in the right and left organ of hearing, and thus are achieved the conditions for the joint presence of two essentially similar sensations in the same field.

Quite similar, however, these two sensations of tone are not, for each one in opposition to the other generates an additional sensation. I place a tuning-fork behind me, strike it, and stop first one ear, then the other, and listen then with both ears. I gain a sensation which is qualitatively and, if my sense of hearing is equally acute on both sides, on the whole quantitatively the same. But there is a difference in that we can separate the three effects of hearing through the additional sensations connected with the *direction of sound*. When my left ear is stopped I hear the tone on the right and vice versa, while when both ears are free the direction of sound is exactly in the middle; I perceive the tone coming from anywhere along the median plane. This interesting phenomenon will engage us at the end of this chapter. Here it is sufficient to notice that the stimulation of corresponding parts of both organs of hearing do produce two sensations abso-

lutely indistinguishable save for the "index of direction"—sensations which in the case of simultaneous stimulation unite in the same "field of sensation."

The appearance of indistinguishable olfactory sensations in the same field is easily analysed as follows (I ought to premise that finding no written information upon the above questions, I was obliged myself to make a series of experiments dealing with olfactory sensations): I had recourse to the well-known method of applying a special system of tubes to each nostril for the inhalation of pure air or of air laden with different scents. The subject of such experiments, if made to inhale through one nostril pure air and through the other vinegar, ammonia, eau-de-Cologne or lavender oil, unless otherwise aware of what is happening, remains convinced that the scents reach him through both nostrils. Only when put upon the *qui vive* by questioning does he admit to thinking that the scents are stronger through the right or left tube. But this assertion is on an average as often wrong as right—a proof that the supposed perceived difference is an imaginary one suggested by questions. Moreover, it is often asserted that no difference is perceptible, this being the case if during the experiment the scented or the pure air is offered first to the right side, then to the left, or vice versa. But on the other hand, and herein is a great difference from phenomena connected with eye and ear, a clear perception is almost always reached when the stimulus is applied no longer to one only, but to both sides. The *acuteness* of perception then rises in a very remarkable manner. One subject asserted that the smell was not sharper nor more concentrated, but rather it seemed as if the liveliness of sensation were heightened.

For the rest, it must be remembered that in the olfactory organ not only does the right gate of stimulation agree with the left as in the eye and ear, but that probably in each portion of the *regio olfactoria* any tract corresponds with any other tract of the same

extent in the sense that no difference can be perceived between sensations produced in one place and those produced elsewhere by the same stimulus. We were led already to this conclusion by the lack of a true side-by-sideness in olfactory sensations, and expressed the fact when saying that all olfactory sensations fall into the same field.

Having learnt the conditions under which "original sensations indistinguishable by direct comparison" can meet in the same field (although with hearing, the statement must be modified to the extent of saying that corresponding sensations, while otherwise indivisible, are yet differentiated, when successive, through the additional sensation of sound-direction). We address ourselves now to the following question, Does the impossibility of directly discriminating between two visual or olfactory sensations produced by equal stimuli acting through corresponding gates of stimulation prove the complete identity of these two sensations? That is to say, other things being equal, do two sensations produced alternately through two corresponding gates behave exactly like two produced alternately through *one* gate? As regards olfactory sensations this question for the present must remain without reply.

In visual sensations Sherrington's experiments in flicker [1] show very definitely that *corresponding visual sensations* produced simultaneously or superposed at intervals do not merge one into another and form a continuum as do repetitions of one and the same sensation arising in the same manner and time.

By a very ingenious system of experiments, Sherrington has, in my opinion, as good as proved this, and the objection which, in one respect, might be made, that in the rapid change of sensations in his experiments the time necessary for the fusion of a right and left

[1] C. S. Sherrington, "On Binocular Flicker and the Correlation of Activity of Corresponding Retinal Points," *British Journal of Psychology*, vol; I, January 1, 1904.

sensation is too short, seems to me of no importance when considered in connection with the agreement between the results of his researches and the observations about to be advanced as to simultaneously corresponding visual sensations.

It is a known fact, which everybody possessing equal keenness of sight and sensitiveness to light in both eyes can prove for himself, that no clear difference is perceptible in the luminousness of perception whether we regard either the grey sky above us or the uniformly tinted wall before us with one or the other eye alone or with both eyes at once, and this fundamental experience clearly demonstrates that the two corresponding sensations do not fuse to form a new summation. Before giving my own opinion as to what happens in this case, I would quote the highly interesting view of Hering—a view which as regards the non-fusion of two corresponding sensations I fully endorse, while preferring, for reasons to be later explained, to substitute for the term "competition," as descriptive of the processes of consciousness, that of equivalence of sensations or homophony. Hering[1] says: "If we fold a piece of paper at right angles in the middle and hold it to the light in such a way that only one half is illuminated while the other remains in shadow, and if then, by squinting, we get both halves apparently overlapping there is competition between the brighter and the darker whiteness. But if by degrees we make the angle of the bend blunter the competition lessens as the difference in illumination of the two halves diminishes and finally seems to cease altogether. It would, however, be a mistake to suppose that it does really cease. We have seen that nearly related qualities of light (or closely related degrees of intensity) continue to compete in the retina, although naturally one's awareness of the fact is less acute, so why should it suddenly cease when both colours are equal? Everything goes to prove that competition goes on even between equiva-

[1] Hering, *Beiträge zur Physiologie*, 5 Heft, Leipzig, 1864, S. 309.

lent colours. If white is presented to both eyes it is perceived the more strongly first by one retina and then by the other." In another place Hering[1] speaks in corresponding terms of the excitation of equally overlapping retinal perceptions. He says: "The competition between the two retinæ prevents a fusion of images and each image preserves a certain independence. As two images cannot enter simultaneously into the space which both have to occupy they compete with one another and predominate alternately." As already said, I entirely agree with Hering's opinion as to the non-existence of a true fusion of two retinal images, and I also think that there is a kernel of truth in what he says of a competition. As regards this I have only one reservation to make. The competition is not to be understood merely as an antagonism, an absolute supremacy, but must be regarded also as a reciprocal strengthening of the two corresponding sensations. The notion of mere antagonism and supremacy is shown to be mistaken once we regard the competition in the following way: Sensation R and sensation L are simultaneously produced and required to enter into the same field. That would make it possible that either R only, or $\frac{3}{4}R + \frac{1}{4}L$, or $\frac{1}{2}R + \frac{1}{2}L$, or $\frac{1}{4}R + \frac{3}{4}L$, or L alone, would enter; and it is easy to show that such is not the case. I doubt if things proceed in this manner even in a typical so-called competition; but certainly they do not in the cases which I describe as homophony of corresponding sensations. Nor, when a sensation on the right is not to be immediately distinguished from one on the left, do the corresponding sensations sum up into one total, either in the sense of a common addition or even in the lesser degree which could be expressed by some formula similar to that of Fechner. A certain reciprocal influence is, nevertheless, unmistakable; and however insignificant, more or less, this may usually be it is quite incompatible with the notion of a definite mutual displacement. Almost immediately, and again in

[1] *Op. cit.*, S. 313.

the chapter on mnemic homophony we shall make acquaintance with circumstances in which the reciprocal influence ceases to be altogether minimal. In the cases then to be considered this change springs from the great numbers of mnemic sensations coming together in the same field. But here where we are considering only *original* visual sensations of which two alone, one on the right and a corresponding one on the left, can meet in the same field, a positive elimination of this junction can be obtained only in the exceptional case of both eyes being experimented upon when the adaptation is to complete darkness.

As already mentioned, when the adaptation is to light, the two eyes together see not at all (or under the most favourable circumstances barely) better than does a single eye. The case is different when, say, after exposure to darkness of about twenty minutes the eyes have become thoroughly accommodated thereto. J. H. Piper found that when darkness accommodation is complete a slide of ground-glass properly illuminated has a much brighter appearance when looked at with both eyes. On an average the illumination had to be increased by $\frac{1}{8}$th or $\frac{1}{7}$th to be as luminous to one eye as previously to both.[1]

Here then we have an example of a remarkable change in one visual sensation resulting from the addition of another of quite similar quality produced in a corresponding place. And this change was a positive one resulting not in the destruction or disappearance of a sensation but in an accession to its obviousness. It is true that the case in point is quite peculiar, one in which the power of perceiving minimal differences in visibility was increased to an unexampled degree, for Piper found in another experiment [2] that an eye accommodated to the dark perceived illuminations at least

[1] J. H. Piper, *Helligkeitsvertältniss monokular und binokular ausgelösten Lichtempfindungen Zeitschr. f. Psych. u. Phys. d. Sinnesorgane*, 32 Bd., 1903.

[2] J. H. Piper, *Über Dunkeladaptation, ibid.*, 31 Bd., 1903, S. 190.

$\frac{1}{1100}$ and in some individuals even $\frac{8}{300}$ weaker than those which the eye can perceive when accommodated to light.

And Sherrington[1] in his experiments on flicker found that there was indeed no fusion among alternate or partially superposed corresponding sensations, but that a certain extremely minute influence did exist, inasmuch as the flicker provoked by alternate stimulation to right and left disappeared in an interchange of light and dark which was in a slight degree slower than when both eyes were simultaneously and equally stimulated.

When auditive sensations come together the same thing essentially happens as with visual sensations, although in one respect there is a difference. Two corresponding auditive sensations are not inseparable in direct consciousness to the same extent as two corresponding visual or olfactory sensations.[2] They do not fuse when simultaneously produced into a homogeneous mass, and the excitations which cause these particular sensations preserve a certain independence for the reason that in their manifestations there enters the peculiar element of a direction of sound. And this happens in such a way that when the excitation on the right is stronger than on the left there is an additional sensation which comes from the former direction, or vice versa as the case may be. Now considering that there is not even a simple subtraction of the weaker from the stronger sensation, how could such a differentiation of two excitations from corresponding localities be possible if a fusion of the two took place? It is plain that for such a differentiation both excitations must remain independent.

As regards this continued state of independence, therefore, two excitations produced in corresponding points of the organ of hearing behave precisely like similar excitations in the organ of sight; but what happens when two excitations of tone react upon one another? Clearly, as in the case of corresponding sensations of sight, they can only manifest themselves in one and the

[1] *Supra ibid.*, S. 59.

[2] *Vide* p. 113, above.

same field of sensation, a peculiarity which we shall dwell upon later. Are we to conclude that in this single manifestation two sensations are merged in one field, or is their meeting, the presence together merely of two unfused excitations, a fact of no importance? We have seen in the case of visual sensations that neither of these alternatives is to be accepted. It must be regarded as established that there can be no question even in auditive sensations of a true summation of two sensations which meet in one field or even of an increase of intensity to any appreciable extent. Stumpf,[1] who has investigated the phenomenon very closely by various methods, was able to find no increase (and similarly no decrease) in the intensity of sensation, when applying the same adequate tone stimulus to both ears instead of to one only. Nor could he or other skilled investigators working with him discover that a stimulus which was just imperceptible by one ear penetrated when applied to both, although in this case two corresponding sensations were produced. A contrary result indeed seemed to be obtained by Tarchanow[2] and Preyer,[3] who were convinced that a sound to which one ear was deaf became just perceptible to both ears. And even Stumpf admits the possibility that one ear may so reinforce the other as to lift over the threshold of hearing a sound which had previously remained below it.

In my opinion while there can be no doubt that any noticeable increase of intensity of sensation when two corresponding auditive sensations come together is entirely lacking, yet the dual right and left sensation is not precisely the same (even setting aside the difference caused by the additional sensation of sound-direction when one or both ears are engaged).

Exactly the same thing happens here as when two corresponding sensations of sight meet in the same field. No perceptible increase of the so-called "inten-

[1] C. Stumpf, *Tonpsychologie*, Bd. 2, 1890, S. 430–9.
[2] *Petersb. med. Wochenschr.*, 1898, No. 43.
[3] *Sitzungsber. d. Jen. Ges. f. Med. u. Naturw.*, 1879.

sity" of sensation takes place in comparison with the manifestation which follows on a one-sided production of sensation. But just as little as the state of excitation of the organ is the same with one-sided or two-sided development is there identity (although great similarity) in the sensations manifested under both conditions. But the change of manifestation which follows on double stimulation is not, strictly speaking, a matter of intensity, since by that we understand the quality of sensations as influenced specifically by the degree of stimulation; it is a change which, while connected to a certain degree with intensity, does not contribute to that special quality; it is, in short, *liveliness* or *vividness*. This distinction is absolutely necessary, as we shall see later on in this work, when comparing mnemic with original sensations. At present it suffices to mention that a mere rustle or crackle—the faintest nibbling of a mouse—strikes very faintly yet distinctly, *vividly*, on the ear; and the same remark applies to nearly every region of sense. *Intensity* in the stricter meaning and *vividness* generally go hand-in-hand, but as will be seen later, they preserve a certain degree of independence.

This is clearly shown by the homophony of mnemic sensations (see fourteenth–sixteenth chapters), which provides cases wherein not merely two sensations (as in binocular sight or twofold hearing) but hundreds of corresponding ones are brought together in a single field, whereby a far more comprehensive change is achieved also in the singular manifestation of sensation. And this change consists essentially in the degree *of vividness*.

This agrees also with what I have observed in myself when comparing hearing with one ear and with both.[1] If while listening to a median tone I remove a plug from my left ear the direction of sound is at once altered from the right to the median plane; and at the same

[1] An indispensable condition for this experiment is equal power of hearing in both ears.

time there is another change which may be described as the penetrability of the sound. It is louder, so to say, richer, it conveys more to me ; it is, in short, *livelier*. I note the same thing when listening with *both* ears at the telephone. I do not hear more loudly but more penetratingly ; and this is the case also when absolute stillness reigns around me, and the second tube, consequently, does not merely serve the purpose of shutting off irrelevant noises. And in this I am in agreement with the overwhelming majority of the inhabitants of Munich, who sorely miss the second tube of late denied them by the post office authorities, although they cannot assert that they are conscious of any consequent diminution in the loudness of what they hear.

A similar result was obtained in binocular sight through an experiment made, under quite different circumstances, by E. Hering,[1] who found that " binocular " sight was, *cæteris paribus*, always more vivid in consciousness than when one eye only was engaged.

But it was in olfactory sensations that my own researches yielded the most conclusive results. My wife, whose sense of smell is less rudimentary than that of most people, was unable to decide whether a scent reached her through the right or left nostril, or through both. But if a scent was presented to her first on one side and then immediately on both sides, she was unfailingly aware of a change in the fullness of the sensation, although unable to specify this as a concentration or peculiar intensity of smell.[2]

The result then of our investigations is as follows : If two (or, as we shall see when considering mnemic sensations, more than two) sensations excited in different localities, but indistinguishable or nearly so by direct comparison, meet in the same field, it is demonstrated that the two corresponding excitations do not merge into one another, but that each preserves a certain degree of autonomy. Under such circumstances it is

[1] E. Hering, *Beiträge zur Physiologie*, 2 Heft, 1862, S. 93.

[2] See above, p. 114.

true that both (or more than two) excitations are manifested by only one sensation; but we cannot, on the other hand, conclude that this single sensation is a product of the fusion of separate sensations. For, firstly, this would be in direct contradiction to the view we took in our introduction as to the relationship between excitation and sensation, and would only have a meaning if we considered each sensation as a separate phenomenon instead of one only which must be regarded under different aspects. Did we accept the idea of a fusion of two sensations in the case in point we should have to correct the views arrived at in our introduction; but there is no need for this, as the difficulty is satisfactorily overcome by concluding that in binocular sight (as when the optical axes are crossed or a stereoscope is employed) the corresponding complexes of sensation produced simply equalize one another or overlap, and that this result takes place whenever sensations of different origin meet in the same field.

To this conclusion, rather than to that of a mere displacement of one sensation by another, we are led by the fact that displacement would not cause the slight increase of strength which is observable in the total manifestation of sensation when compared with its single components—an increase which, as we have seen, is not to be expressed in terms of *intensity* but in that of *vividness.*

It follows from all this that in the cases before us the resulting condition can only be described or, if preferred, symbolized by the expression "identity"; for which condition I choose the term *homophony of sensations.* So far we have considered only the homophony of two *original sensations,* or, looking at it from the other side, *two original stimulations.* In accordance with the views expressed in our introduction we could indeed also speak of *homophony of excitations*; but I prefer not to investigate this side of the subject at present. It was not exhaustively examined even in *Mneme,* and must await consideration at some future

time. In the seventh chapter of *Mneme* I described the process which I call "homophony." When finishing the first edition of that work (1904) I knew of homophony only between an original sensation on one side and one or more mnemic sensations on the other, or between mnemic sensations alone. I had not yet recognized the fact that two corresponding original sensations (binocular sight or twofold hearing) or even numerous original sensations (proceeding, for instance, from different parts of the *regio olfactoria*) might be homophonic. Only later was the similarity between these various processes made clear to me.

Study of the homophony of original sensations is susceptible of close experimental proof, and thus contributes most satisfactorily to our complete conception of mnemic homophony, which—on its side—throws light in many respects on obscure points of the former. Especially does it contribute to our insight into that increase of *vividness* which is difficult to demonstrate in the case of homophony of original sensations.

At the end of this chapter we shall debate the effect of the presence of small and partial differences within two complexes of sensation which have attained to homophony. For we must not forget that in homophony we have to deal, as a rule, with *complexes* of sensations, although for the sake of brevity we may inaccurately speak of sensations only. Through the identifying process of homophony a good opportunity arises of detecting slight divergencies in particular portions of a complex. Thus one complex can be distinguished from another as a whole in respect, for instance, of intensity (brightness, sonority, etc.). Farther on, when dealing with the much wider sphere of mnemic homophony, I shall describe the categories of homophonic identification which admit or do not admit of such distinctions as "differentiating homophony" and "undifferentiating homophony."

In binocular sight and di-otic hearing, the homophony of original sensations is, as a rule, bound up with

a differentiation which, so far as I know, is altogether wanting in the sense of smell. The position of our ears causes, for all sounds which do not reach us on the median plane, a difference of intensity between the right and left homophonous sensations of tone. For the rest, even when stimuli are identical, there is an essential difference between the sensation of one ear and the other owing to that additional "direction" element of sensation.[1] It is therefore obvious that when the stimulus is median there must be some differentiation.

The difference of position of the two eyes in respect to a common perceived objective results in homophonous optical sensations which, inasmuch as right and left, differ in some details while remaining alike in many others, thus causing a diversity in the contour of the two homophonous images, although the larger space within the outline exhibits, in the main, no dissimilarity.

I describe as *differential sensation* the effect of this diversity as far as it is felt to be a peculiarity adherent as a separate element or addition to the basic homophonous sensation. It is the expression of an *antagonistic* action of two components, and may be regarded as a function of the antagonism.

The origin of this differential is not necessarily revealed in any way by its manifestation in consciousness, or when so betrayed it is merely by indirect deduction. For instance, the differential of intensity in two corresponding auditive sensations lies in the *direction* of sound; the differential in two complexes of corresponding visual sensations where the contours a little displace each other is felt as a difference of projection. When we come to deal with mnemic homophony we shall get to know a similar, I might almost say a metaphorical, language on the part of the differentiating factors in sensation.

In di-otic hearing, as already mentioned, all sensations of sound of which the stimulus proceeds from the median plane are homophonously more intense on the

[1] For which see above, p. 113.

right than on the left side; and the contrary happens when the stimulus is to the left of the median plane. It is on account of the difference in intensity of the right and the left sensation that there arises a sensorial differentiation which, as already stated, accompanies the fundamental homophony, in other words a specific quality telling us the *direction* of the sound. When the greater intensity is felt on the right, the result of differentiation is that the sensation of sound comes from that side; and vice versa when the superior intensity is on the left.

When intensity is equal on both sides, then the direction of the sound is neutral; it comes from the median plane.[1]

I would here briefly anticipate an objection. One might imagine that the sensation of direction in the stronger sound when a stronger stimulus is applied to one ear was something of the nature of a sensation in the organ itself and had nothing to do with the special sensation of tone, or was, at least, only of secondary importance in this way. But this cannot possibly be. The awareness that one ear is more strongly stimulated than the other can follow only on a comparison of the two stimuli—that is to say, of the two excitations caused by stimulation. And these excitations are not general excitations but in each case are specific, acoustic ones, that is they manifest themselves through special sensations of hearing. These are the sole sensations afforded us by normal, non-painful hearing, for we hear without any awareness of the participation of the auditive

[1] This localization to the right, the left, or the middle follows from the differentiated homophony of the two corresponding auditive sensations. It is, however, the only form of localization which is undertaken by normal nerves of hearing. The localizations, "above," "below," "behind," "before," are not established in the same way, but follow on the turn of the head to left or right, etc. Were this assistance denied to us, any conclusions in the matter would be absolutely untrustworthy, and could only be founded on indirect criteria. (*Vide* K. L. Schäfer, "Gehörssinn," S. 578, in Nägel's *Handb. der Physiol.*, 3 Bd., 1904.)

organ as such (see pp. 93–4). It follows therefore that the sensation of sound-direction is a differential which is only arrived at through a comparison of acoustic sensations.

I now turn to the differentials of sensation which arise from the homophony of binocular sight, and, in the first place, the particular differential which expresses itself as a sensation of depth and genetically, that is with respect to its origin in stimulation, is attributable to a slight incongruity in the contours of images perceptible by both eyes. As already stated this incongruity, where not too distant objects are concerned, depends upon the distance of 60–70 millimetres between our two eyes. Where there is complete congruity in the objects presented to the right and left eye no differential sensation arises, hence no awareness of depth, except when another cause comes into force, as may happen with the addition of mnemic sensations. These result from experience of the play of light and shade, of aerial perspective, and so on, and are elicited (ecphorized) from the store of engrams. (We shall study these in the following part of this work.) For instance, a distant mountain does not appear any more cubic when beheld with both eyes instead of with one only. The effect of relief here depends entirely upon the play of light and shade and vanishes altogether when a certain position of the sun (near the zenith) causes everything to be equally illuminated from above.[1]

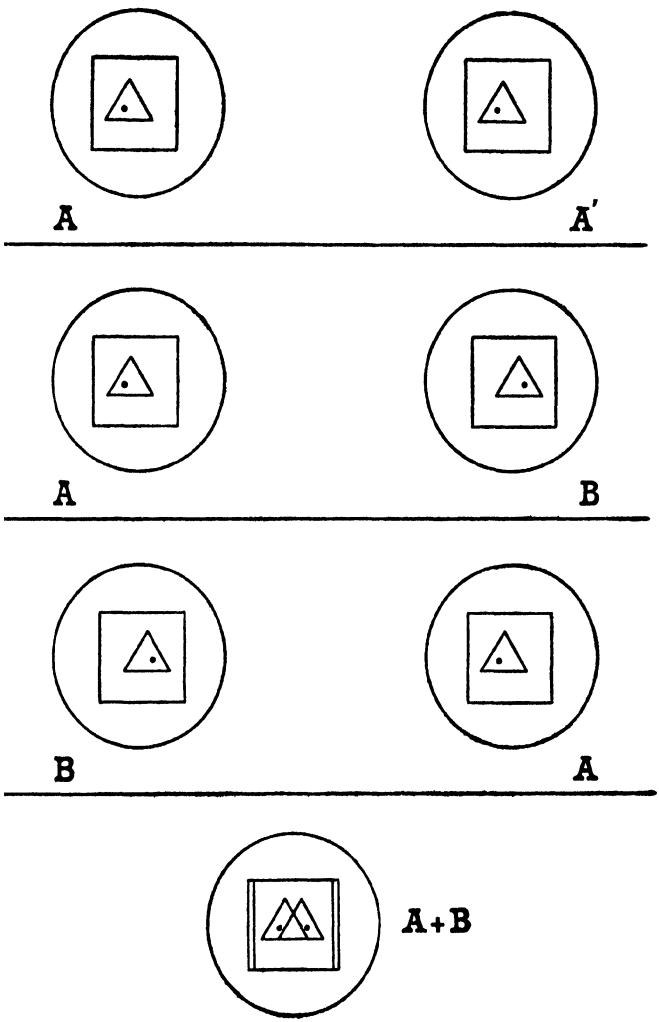
The best means of studying sensations of depth (relief) as purely original, that is as a differential of sensation through the homophony of two corresponding original sensations—and the best because of precisely the elimination of all mnemic admixtures—consist in two linear drawings, not entirely identical in contour, presented the one to the right, the other to the left, eye and which, either through a crossing of the optical axes (squinting) or by employing an apparatus like the stereoscope or haploscope, are reduced to a condition

[1] See E. Hering, *Beiträge zur Physiologie*, 1 Heft, Leipzig, 1861, S. 77.

of homophonous congruity. The figure at page 129 shows in each of the first three rows a couple of figures which have to be reduced to congruity. The rows differ in this that in the first one the almost identical figures A and A^1 are presented to the two eyes, while in the second row A is offered to the left, B to the right eye, and in the third row this order is reversed. If both figures of the first row are made congruous then, owing to the absolute identity of the circles, squares, and dots, there is no differential sensation and no relief. Here the two right angles are not in precisely the same relation to their surroundings, only the unintentional fault in drawing is so minute that a casual observation of the two figures side by side does not reveal it; and a very competent draughtsman who had had the matter explained to him and conscientiously applied measurements with compass and rule was yet unable altogether to avoid making this error in drawing. Yet so sensitive are our eyes to this infinitesimal difference in homophony that in stereoscopic vision the right angle is clearly seen behind the circle, the square, and the dot. It is well known that this extreme delicacy of homophonous differentiation is what, according to Dove, allows of the detection of the most perfectly imitated false banknote.

Much more conspicuous, naturally, is the differentiation, and much more striking the degree of relief, when the figures to be made congruous are of greater diversity. The second row in the binocular picture brings the circle in the plane nearest to the beholder, while the square is a long way behind it, the right angle is farther still behind the square, and the dot is farthest off of all.

The binocular picture furnished by the superposition of both figures in the third row yields much the same result; only the distribution of the components to the two eyes is reversed; and to this corresponds an exactly reversed differential in sensation. The outer circle is then farthest off and the dot is in the plane nearest to the observer.


A
A'
A
B
B
A
A+B

In the fourth row the figure shows what happens when A and B are made congruous by being superposed. This picture enables us to see what may be called the elementary condition of the differentiating homophony. This condition is not realized by the majority of observers, that is to say it is not felt as such, but it is by no means an unreality. For, when A and B are binocularly united, investigators who are practised in the analysis of stereoscopic optical impressions see the resulting figure under an aspect not entirely different from the figure in the fourth row. Hering[1] says: "I am able to assert that in delicate stereoscopic linear drawings I can almost always distinguish the parts not entirely identical and that most of the pictures accompanying treatises on stereoscopic sight are for me quite useless towards forming a stereoscopic image; I always see the greater part double and only get a stereoscopic impression by voluntarily moving my eyes. The greater my practice and care the more easily do I perceive the not absolutely identical impressions as separate. It is extremely easy to overlook double images; but under certain circumstances to perceive them is extraordinarily difficult."

The majority of observers see single contours instead of the double ones which result from corresponding stimuli striking different rods of the retina in the right and left eye, and a complete stereoscopic effect is only achieved when sight is thus simple and simultaneous. But this process is only a translation, so to speak, of the differential of sensation arising from the doubling of outlines which Hering has described—a "translation" which, as we have seen, may fail in the case of even very good observers when all sensations of relief arising from mnemic elements are eliminated.[2]

[1] E. Hering, *Beiträge zur Physiologie*, 2 Heft, Leipzig, 1862, S. 107. See also 5 Heft, 1864, S. 334 and 337.

[2] For the rest, the perception of relief does not depend solely upon seeing outlines as single, for even when these are seen doubled the element of relief is a decisive, if not an equally emphatic, factor See Hering, *ibid.*, p. 330.

In homophonic comparison of the "covering" or congruous figure we meet with astonishing acuity of cubic vision (*Tiefensehschärfe*), that is acuity of the sense of incongruities presented by images of the right and left eyes. We have shown in our explanation of the first row of figures at page 129 that such visual acuity is much greater than that of the discrimination of contiguous lines and dots where one eye only is engaged. Only under especially favourable circumstances does an eye attain a visual acuity amounting to ten seconds of an angle, but in binocular sight homophonous differentiation will, under almost all circumstances, clearly recognize differences in relief of ten seconds and where the conditions are highly favourable a deviation of even five seconds is perceptible. Still more significant is the fact that homophonous differentiation enables the slightest difference between the images before the right and left eye to be perceived. Without homophony any such difference is imperceptible; a fact which anybody can be convinced of by the following experiment with the figure at page 129. Take the second row A and B, then by squinting or using a stereoscope of which the sights have been brought excessively close together, a covering (or adjustment) is obtained which gives three images at once. Of these the middle one, being seen binocularly, is stereoscopic, while the neighbouring images to right and left are each seen with only one eye and in a single plane (or two dimensions). No uninitiated person making this experiment guesses that the binocular image on the left is seen with the right eye and vice versa, and when the subject of the experiment, having first one and then the other eye covered, is finally convinced of this fact he feels great astonishment. The principle is applied by oculists in the construction of spectacles for detecting simulated blindness of one eye, for it invariably happens that the unwary subject is mistaken about the eye with which he really sees.

The differential of sensation in homophonous con-

gruence results, on the contrary, in everybody perceiving the distinction with absolute certainty, as may be shown at once by comparing the reversed stereoscopic effects in row 2 and row 3 at page 129.

It is a matter of course that we have here used the study of relief-perception only in so far as it affords an example of the general law which we have described as homophony (congruence of sensation) and the formation of differentials of sensation; and furnishes especially an example of the formation of differentials between two original sensations. Beyond this any deeper study of the problem of binocular relief-perception,[1] a study as interesting as it is difficult, is barred by its being subsidiary to our special theme. Fortunately the account we have just given in our own terminology, and within the limits of our subject, is sufficient to exclude any hypothetical misconceptions.

This differential of sensation in relief-perception arises in homophonous sight, as we have seen, when a partial incongruence in contours is visible to the right and left eye. Another kind of differential of sensation in binocular sight occurs when the degree of illumination of an image is not the same for both eyes. This differentiation is one of intensity, therein entirely resembling the differentiation of sound-direction which we found when describing acoustic phenomena.

It is true that in the optical sphere this differential finds a quite peculiar expression consisting in a relative dimness or haziness in the organ of sight. Von Brücke and Brückner,[2] who have made a study of this particular

[1] See especially the classic researches of E. Hering in *Beiträge zur Physiologie*, Leipzig, W. Engelmann, 1861–64. Also "Die Lehre von binocularen Sehen," Leipzig, 1868, and "Der Raumsinn u. die Bewegungen des Auges," in Hermann's *Handbuch der Physiologie*, Bd. III, 1, 1879. Hering's conclusions are contested by Helmholtz, *Handbuch d. physiol. Optik*, 2 Aufl., 1896, S. 960–70.

[2] E. Th. v. Brücke and A. Brückner, *Über ein Scheinbares Organgefühl des Auges, Pflüger's Archiv*, Bd. 91, 1902. Cf. also the treatises by the same writers, *Zur Unterscheidbarkeit rechts- und linksaügiges Gesichtseindrücke, ibid.*, Bd. 90, 1902.

sensation and the conditions of its production, describe it as a feeling of loss of sight, and I shall speak of it under this title. Most persons experimented upon speak of a blurring of their sight. It occurs to the greatest extent when one eye is bandaged for a quarter of an hour while the other is exposed and gradually becomes accustomed to very bright light. If the bandage be then removed and both eyes are exposed to a half-light, the blurred sensation (*Abbleudungsgefühl*) is extraordinarily strong and lasts with diminishing intensity until the two eyes come to be affected alike.

But that this is simply caused by a differential of sensation in the homophony of binocular sight is proved by the circumstances that, in my case at any rate, the sensation ceases as soon as *I shut off one eye by closing the lid.* Von Brücke and Brückner make no mention of this phenomenon in their otherwise very careful treatise; and they express themselves in a manner which if not inaccurate is at least unfortunate and apt to cause misunderstandings when they say: "The difference in the image is most marked when one eye is altogether precluded from seeing." [1]

That this is incorrect can easily be proved by the following experiment. If one eye is bandaged and the other gradually accommodated to a bright light (a process during which there is no feeling of being blurred) and the subject, still with one eye bandaged, is exposed to half darkness the free eye sees little or almost nothing but has no blurred sensation. *That* only comes when the bandage is removed. With me, however, it ceases the moment I close or bandage the eye which has been accommodated either to a bright or a half light. And in yet another way I am able to prove to myself that the blurring is the typical differential sensation of homophonous binocular sight. If, when reading under usual conditions for both eyes, I shut one I have no blurred sensation; but if, while still reading, I keep both eyes open and hold a piece of black paper in front

[1] *Ibid.*, S. 370.

of one or otherwise interfere with its function but without closing it entirely so that it is still capable of seeing, I am then conscious in a high degree of the sensation in question.

Although I say that " the eye is still capable of seeing while the paper is held in front of it," I mean that by diverting its power of attention I practically preclude the act of seeing with it and thus prevent the occurrence of the blurred sensation. Not to see a dark field of vision when a lid is closed or an eye bandaged means that under such circumstances the eye is deprived of the power of seeing. In all these cases the darkened field of vision being inoperative is cut off from competition; but on the other hand when two quite different images are presented to both eyes, that is when there is competition in the whole visual field, the blurred sensation does not occur. A proof of this can be had by using the microscope while the experimenter leaves his unemployed eye open.

The blurred sensation is, therefore, a typical differential and can only arise when there is complete homophony between the two complexes of sensation which we have been considering.

In this chapter we have studied the phenomena of homophony and differential sensation only in so far as *original sensations* have contributed to their production. Thus limited, what has been written is merely preliminary to the much fuller treatment which the subject will receive in the following chapters. As the full extent of homophony in the mnemic sphere and in relation to the interplay of mnemic and original sensations will then be apparent, the materials with which we are provided for the study of facts will for the first time be conveyed and tested.

SIXTH CHAPTER

THE ACOLUTHIC PHASE OF ORIGINAL SENSATIONS

In my book *Mneme* I distinguished between synchronous, acoluthic, and engraphic effects of stimulation. A "synchronous" effect is that which ceases immediately with the cessation of the stimulus; "synchronous original excitations" are those which that stimulus awakens; and "synchronous original sensations" are their manifestations in the sphere of sense. As regards acoluthic effects of stimulation I expressed myself as follows.[1]: "A very intense or prolonged effect of stimulation sometimes causes such profound changes in the state of an organism, that for it to settle down again to return to its original condition some considerable time after the stimulus has ceased is necessary just as the sea after a great storm only reverts by degrees to calm." We are accustomed to describe this process as the dying down of an excitation (*abklingen der Erregung*). When several discontinuous excitations follow one on the other so quickly that the earlier are overtaken by the subsequent ones, the results of excitation come ever more and more to resemble a single prolonged constant excitation and arouse in us continuous sensations —(cf. the continuous colouring of a rapidly rotating variegated top, or the single tone of a quickly turning Savart's wheel). To the same class (even when one cannot speak exactly of dying down) belong "after-images" and "after-tones"; also the convulsive jerks and continued contractions which follow on a prolonged stimulation of the muscles through electricity. Such after-effects,

[1] 2 Aufl., S. 18.

which always vanish without trace some time after the stimulus has ceased, are not distinguishable in principle from synchronous effects of stimulation, not even when the pendulum of reaction swings over-much to the other side as is, for instance, the case in the negative "after-image."

To describe these after-effects which are immediately connected with synchronous ones I have chosen the term "acoluthic."

We have now to concern ourselves with the manifestations in sensation of such acoluthic excitations or acoluthic sensations, but naturally only so far as the study is necessary for our chief theme, which is the understanding of mnemic sensations and the law which governs these.

As regards the duration of the synchronous phase of original excitations due to a constant stimulus, we recognize, as is well known, a rapid increase of synchronous excitation (or synchronous sensation), up to a maximum. Exner's [1] interesting experiments in light-stimulations teach that this maximum is reached in a time which varies, according to the intensity of stimulation, from $\frac{3}{10}$ to $\frac{1}{10}$ of a second. When the maximum has been attained the excitation continues nearly constant, but only nearly. Strictly speaking, what happens is an extraordinarily gradual and slow but continuous decline of the excitation and, with it, of the resultant sensation. The reason for this decline of the synchronous excitation and corresponding sensation under the influence of a continuous stimulus is clearly explained by Helmholtz when referring to optical sensations. In his *Physiol. Optik* [2] he says: "The impression received in the first instance lasts a certain time. With this, and strengthening it, is immediately associated the impression produced during the second fraction of time. And the process so

[1] S. Exner, *Über die zu einer Gesicht's wahrnehmung nötige Zeit. Sitz. Ber. d. Wiener Akad.*, Abt. II, Bd. 58, 1868 (referred to in Helmholtz's *Physiol. Optik*, 2 Aufl., S. 513). See also Kunkel, *Pflüger's Archiv*, Bd. 9, 1875, S. 197; E. Dürr, *Philosoph. Studien*, Bd. 18, 2; Martin's *Beitr. z. Psychol. u. Philosoph.*, I, 3.

[2] 2 Aufl., S 513.

continues with each successive impression. But at the same time each nervous reaction revealed as sensation leaves behind a certain degree of nervous exhaustion which vanishes slowly under the restorative influence of arterial blood. The succeeding light-impressions combined with the decreasing after-effects of the former ones no longer produce the same high sum of results as the first impressions coinciding with minimum fatigue of the eyes. It follows that continuous light-stimulation produced at first a sensation which rises quickly to a maximum and then begins to decline."

The principle here explained must necessarily apply not only to synchronous excitations and sensations in the sphere of sight but to all spheres of sensation equally. Experiment also proves an increase in sensations of sound, and Exner[1] says that the maximum is sooner attained by deep tones than by high ones. According to Urbantschitsch,[2] it is only reached by a weak stimulus in 1 to 2 seconds. But in this respect individual differences are very remarkable. Our special aim does not require a closer study of the duration of synchronous sensations, and we can consequently leave this field of inquiry, which is beset with difficulties as regards the numerical precision of evidence.

In the acoluthic phase excitation, of which the intensity begins to diminish rapidly when the stimulus ceases, that is when the synchronous phase is over, until at last there is no forcible manifestation left, results nevertheless in sensations which we describe as acoluthic, and which are divisible into two sub-phases. In the first sub-phase the intensity of acoluthic sensation is so remarkable that the said sensation is produced without any further assistance. In the second sub-phase, however, the intensity has so diminished that the acoluthic sensations only arise under peculiar but constant conditions.

It is evident that the first phase must merge insensibly into the second.

[1] Cf. *Pflüger's Archiv*, Bd. 13, 1876, S. 234.
[2] *Ibid.*, Bd. 25, 1881, S. 323.

Here again we can study the relations best in the visual sphere, and there exists an abundant literature which in various ways and under different titles is devoted to the direct after-effects of synchronous optical excitations. These after-effects are of different sorts. They consist for one thing in ons and offs, oscillating in a peculiar manner which we shall see better further on, and next in secondary effects such as a change of tone in the optical substance or fatigue or induction.

With these secondary phenomena in the after-effects of synchronous excitation we propose to concern ourselves here as little as possible. In any case, we wish to select out of the mass of facts only those which have a significant bearing upon our thesis, and we content ourselves therefore with examining more particularly the acoluthic effects of very brief light-stimuli.

For this purpose two methods can be employed. Either a particular portion of the field of vision can be illuminated momentarily by a flash of light, or a light-emitting object can be moved across the field for a certain time before the fixed eye. Both methods have advantages. Observation is clearly more conveniently carried through, and easier to analyse in detail, with the movable object; and this method, since Purkinje, Hess, and Bidwell, has generally been adopted by most investigators. Investigation by the other means (the fixed object) possesses certain technical and practical difficulties, but has the advantage of offering us the simplest possible case.

When V. Kries[1] says: "There was no perceptible difference between the two experimental processes (i.e. the stationary and the movable object), I do not wish to contradict him, but should like to lay stress on the fact that it is not possible simply to deduce the result of one method from that of the other, and that up to now McDougall[2] alone has attempted to carry through the

[1] Cf. "Gesichtsempfindungen," in Nagel's *Handb. d. Physiol.*, Bd. III, 1904, p. 221.

[2] McDougall, "Sensation, etc.," *British Journal of Psychology*, vol. I, p. 1, 1904.

deduction in detail. And his attempt, although it succeeded perhaps in principle, requires to be verified in many respects, and in any case the question remains an open one. Fortunately the doubtful points have no bearing on our special task and can be eliminated from it.

A particular portion of the field of vision is illuminated by a fixed, momentary stimulation of which the duration can be regulated by various mechanical contrivances, such as photographic snapshots, successive films or electric discharges in rarefied space. McDougall, who repeated these observations after C. A. Young and Bidwell, reports [1] that under favourable circumstances and with stimulation from a ray of particular intensity which lasted $\frac{1}{20}$ of a second, the first flash from his circular illuminating apparatus was repeated a second, third, fourth, and even seventh time. The interval between each flash is so short that one cannot say if the first sensation had quite expired before the next was felt.

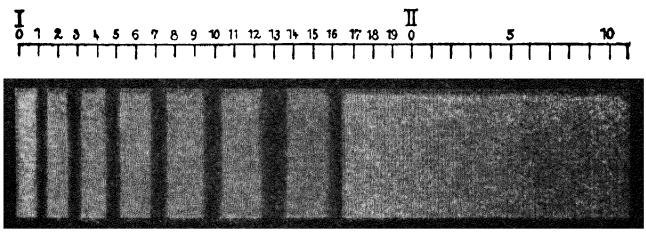
McDougall describes these rapid repetitions of the same sensation as *pulses*. We would describe them as oscillations of the sensations. In the series of these oscillations the first numbers succeed one another more rapidly than the later ones, and each successive oscillation is weaker than its predecessor. The whole series lasts perhaps $\frac{3}{4}$ of a second. Immediately on the dying away of the last of these oscillations (which consist of a flicker of light and darkness in the same visual sensation) there appears in the same place an indistinct (in McDougall's experiment, a grey), stationary after-image which may endure some 20 seconds. We do not need to inquire here whether this after-image is followed by others, although Hess's experiments in the after-images of movable objects makes me think that probable.

In the following drawing I attempt to show the beginning of the process of sensation in question and its relations to time. The scale at the numbered end shows the time-divisions, each division corresponding to $\frac{1}{20}$ of a

[1] *Ibid.*, p. 85.

second. As we see, the oscillations cease in about $\frac{3}{4}$ of a second, or immediately after the fifteenth line, and after a brief interval of darkness the after-image begins at 16, its commencement, that is its subsistence during the first $\frac{3}{4}$ of a second, being alone represented here. It may, as we have said, last 20 seconds, and is probably followed by further after-images, which, however, are not shown under the present conditions of experiment.

In this drawing the oscillatory portion of sensation is shown as seven oscillations divided from one another by intervals of incomplete darkening. The first oscillation lasts $\frac{1}{20}$ of a second, that is to say as long as the stimulus which has provoked it. *Strictly speaking this oscillation is alone to be described* as a synchronous sensa-



tion. Oscillations 2 to 7 which last $\frac{2}{20}$ to $\frac{16}{20}$ of a second are really acoluthic phases of sensation, and so, naturally, is the after-image which subsists even for 20 seconds, not to speak of its possible successors. The duration of the acoluthic to the synchronous sensations is then as 20 to $\frac{1}{20}$, that is as 400 : 1. But of course the longer the stimulus endures the more lasting in proportion are the synchronous sensations.

We have said that the acoluthic phase of sensation is divisible into two sub-phases; one in which acoluthic excitation manifests itself regularly in sensations above the threshold of consciousness; another in which this manifestation only arises under special and favourable circumstances.

In the case under consideration the six acoluthic oscillations (2 to 7) probably belong to the first phase,

that is to say they are mostly above the threshold of consciousness, and peculiar conditions of sensation are required for their production. Under ordinary circumstances they would be felt as a single long-enduring impression. For the oscillatory element to become perceptible special experimental arrangements are necessary. The after-image which lasts 20 seconds and its possible successors belong certainly to the second phase, as being producible only under special experimental conditions. That it is *always* produced under such conditions is a proof that the acoluthic excitation which attaches itself to a synchronous excitation lasting $\frac{1}{20}$ of a second surpasses the latter in duration 400 times.

Had these reflections on the effect of brief stimuli started from the consideration of a movable object we should, so far as the present is concerned, have arrived at absolutely identical results.

It has already been pointed out that it is difficult to bring the separate phases of the two kinds of observation into harmony with one another; but these difficulties have no relation to the facts on which we have based our conclusions.

Fundamentally there is no difference between the visual sphere of sensation and that of any other sense. But convincing proof of the duration of acoluthic sensations, especially in connection with the phases through which they emerge into notice, is much more difficult, and the facts bearing on them are very few.

In acoluthic auditive sensations only the first moments of the first sub-phase have been closely studied, the moments that is, during which the intensity of the acoluthic sensation is not noticeably distinguishable from that of the previous synchronous effect, in which their level has not yet perceptibly fallen.

The experiments are directed to show what is the duration of the interval between two tone-stimulations following one on the other, during which successive sensations are felt as continuous and no longer as discontinuous. Consequently we have here a result quite similar

to that of the optical experiment mentioned at page 86, whereby we were shown the rapidity with which discontinuous stimuli of light must follow one another in order that the observer may receive one constant sensation from separate flickerings.

From these experiments in the transformation of a flicker into one continuous illumination it follows that the rapidity of change in the phases, which is necessary to destroy the flicker and substitute a sensation of continuous light, differs according to the nature and extent of the lighting as well as in each individual case. In the experiments instituted by Sherrington [1] the alternate phases of light and darkness lasted as a rule, and on an average, $\frac{1}{270}$ of a second before the flicker became perceptible.

We have to thank Mach [2] for the first accurate researches in the sphere of hearing. Later Alfred A. Mayer,[3] with the help of methods resembling those of Mach, proved that the duration of intervals in which a succession of tones is felt as continuous differs remarkably according to pitch. Mayer found that for the low C it was $\frac{1}{269}$ of a second and for thrice-accented C $\frac{1}{264}$ of a second. In other words a series of very low tones is merged into one continuous sensation in a time which is seventeen times longer than for a series of much higher tones.

Urbantschitsch [4] got somewhat different figures in similar experiments, but the diversity was to be explained by a difference in the methods employed.

He also found that the length of the pauses between single tones which results in continuity or discontinuity was much greater with low than with high tones. We

[1] C. S. Sherrington, "On Binocular Flicker and the Correlation of Activity of Corresponding Retinal Points," *British Journal of Psychology*, vol. I, January 1, 1804.

[2] E. Mach, *Sitz. Ber. d. Wiener Akad. Math. Naturw. Kl.*, 2 Abt., Bd. 51, 1865.

[3] A. M. Mayer, *Philosophical Magazine*, 37, 1894; *American Journal of Science*, 47, 1894.

[4] Urbantschitsch, "Über das An- und Ab-klingen akustischer Empfindungen," *Pflüger's Archiv*, Bd. 25, 1881.

do not need to go into the details of these experiments and their results, as all that they demonstrate is the measure in which the intensity of the acoluthic sensation approximates to the degree of intensity of its synchronous predecessor and generator. Misunderstandings may arise when, as is not seldom the case, it is said that the above figures express the time which is necessary for the " complete dying down " of a momentary acoustic stimulation.

I mention this only to affirm the fact that neither in these experiments nor in those with flickers is there any question of " complete dying down." In Sherrington's experiments with flickers, these follow conspicuously when the pauses between the separate stimuli of light amount to only $\frac{1}{200}$ of a second. But that the sensation does not desist entirely in this interval of time is shown by the experiments given at page 139, which prove that even the first oscillatory phase of acoluthic sensation, even when the stimulus is brief and relatively weak, lasts $\frac{3}{4}$ ($= \frac{150}{200}$) of a second, that is to say, more than 150 times longer that the aforesaid fraction ($\frac{1}{200}$) of a second. And if the successive phases of acoluthic sensation are also reckoned in, the duration increases a thousandfold. When (as seen in the sphere of hearing) $\frac{1}{27}$ to $\frac{1}{200}$ of a second (according to pitch) is required for the dying down of intensity in an acoluthic sensation after the stimulus has ceased so that a new synchronous sensation of equal force sets up alongside it, evidently the entire expiration of sensation must require an immensely longer time. The duration must increase a hundred- or two hundredfold if we only consider the first phase of acoluthic auditive sensations, and leave aside altogether the *bona fide* after-images.

But a more accurate and satisfactory acoustic measurement has, for purely technical experimental reasons, not yet been achieved.

The measurements made by Mach, Exner, Alfred M. Mayer, Schäfer and Abraham, as well as by Urbantschitsch who has concerned himself with what he calls rapid " dying down," have all been limited to the determination

of the moment of time during which there is no observable decrease of intensity in the acoluthic sensation.

I would describe the result so obtained as the average level of intensity of sensations; and there is no particular difficulty in accurately computing the length of this measure of time.

The only experiments known to me for examining the whole dying away of sensations and its duration are those of Urbantschitsch,[1] who after describing as a "primary acoustic after-sensation" (after-resonance or echo) the slow dying down of a sound, also endeavoured to investigate under the title of "positive acoustic after-images" the "secondary acoustic after-sensations" following on the first.[2] According to him the duration of the primary acoustic after-sensation is limited sometimes to 1 to 2 seconds, may extend, however, in some cases to 10 to 15 seconds, and with one person experimented upon a high tuning-fork only ceased to sound after 19 seconds. This refers therefore to the first phase of an acoluthic acoustic sensation, and after this follows, according to Urbantschitsch, 2 to 3, sometimes 6 to 8 or more acoustic after-images, interrupted by pauses. As to the time which they take Urbantschitsch says: "The duration of acoustic after-images from the cessation of the objective tone to the dying away of the last after-image, is usually one minute, sometimes two, only rarely more. The duration of each separate after-image fluctuates between a rapid passing spurt and an after-sensation lasting quite two minutes. At most the after-image will last from 5 to 10 seconds. Equally uncertain is the duration of the intervals between each after-image."

As regards these results and Urbantschitsch's researches generally, I find myself in a peculiar position. On one side I am convinced that the dying away of an auditive sensation takes a relatively long time extending perhaps

[1] V. Urbantschitsch, "Über das An- und Ab-klingen akustischer Empfindungen," *Pflüger's Archiv*, Bd., 25, 1881.

[2] V. Urbantschitsch, "Zur Lehre von der Schallempfindung," *ibid.*, 24, 1881.

to one or more seconds, and which, in any case, is an immense multiple of the maximum duration of intensity, which is from $\frac{1}{27}$ to $\frac{1}{200}$ of a second. Also I think it very probable that there is oscillation in acoluthic auditive sensations just as in visual sensations; and possibly the phenomena which arise correspond to optical after-images. Nevertheless I much doubt whether the results or most of the results obtained from the persons whom Urbantschitsch experimented upon are to be accepted as manifestations of dying acoluthic auditive sensations. I think that his experiments in positive acoustic after-sensations [1] and in the gradual dying down of his "primary acoustic after-sensations" [2] were insufficiently guaranteed against the intervention of suggestion. At least his brief indications of the methods of experiment give no security and one finds in them no essential objective fact, and especially no information as to the constancy of evidence on the part of each person experimented upon when the objective stimulus was repeated. In Urbantschitsch's communications there is, on the contrary, great inconsistency and curious vacillation, not only in the testimony of different persons but also in that of the same person under different experimental conditions. Moreover, the most numerous and remarkable results were obtained from persons with defective, not with normal, hearing. Now I think that such a person being much more accustomed than one with normal hearing to deal with insufficient sensations—to connect them with every possible kind of indication and generally to conclude that he hears less than others—is much more susceptible to auto-suggestion than a normal hearer; and in any case is to the last degree unsuitable for experiments of a delicate nature. I entirely believe that Urbantschitsch undertook, and reported on, his researches in the most conscientious manner; but the methods he employed do not seem to me to offer trustworthy results, especially because (setting aside the want of a

[1] *Pflüger's Archiv*, Bd. 24, 1881.
[2] *Pflüger's Archiv*, Bd. 25, 1881.

proper control through repeated experiments on the same person and comparison of effects) it is extremely difficult, as anybody may prove for himself, to establish the complete dying down of an auditive sensation in a given fraction of a second and to register the same accurately without a voluntary effort.

It is much easier to note and register the moment when an auditive sensation *arises*, and this fact in my opinion offers a trustworthy method of measurement. If I may judge by my own attempts, the following method of experiment furnishes useful results. The loudness of a lasting tone or noise can be accurately recognized, in surrounding complete silence, as coming from a particular place. Then while the first tone still goes on one must set up a totally different tone or noise of such strength that it entirely overcomes the first. In a short time the second sound must cease while the first continues and naturally again becomes sensible. I then find that a brief interval of time is always necessary before the first sound becomes again perceptible, and if one registers chronometrically first the objective suspension of production of the second sound and next the revival of the first, the difference of time does not cover the total extinction of the second sound but only that during which the gradually ceasing sensation was strong enough still to overpower the very weak reviving sound. By varying the experiment one can eliminate the possible losses of time consequent on necessary changes of accommodation in the ear-drum (supposing that such must anyway be taken into consideration).

Some preliminary experiments which I undertook in this matter showed me that also in auditive sensations the acoluthic phase lasts an equally longer time than the average level of duration (1,27 to 1,200 seconds). Unfortunately I had no opportunity in Munich to carry through these simple experiments with proper instruments, and consequently many conclusions must remain unsubstantiated until some other investigator undertakes careful researches into this question, which has importance

as bearing upon the problem of successive associations.[1] Without for the moment founding any numerical generalization upon my own researches I will conclude with the following reflection:

In visual sensations we computed that with a very brief stimulus the duration of the average level of intensity (about $\frac{1}{200}$) was to the duration of the first oscillatory phase of extinction (*circa* $\frac{3}{4}$) as 1 : 150. As the average duration of intensity in acoluthic auditive sensations is much longer than in acoluthic visual sensations we are justified in assuming for the first at least as gradual an extinction of the initial acoluthic stage as for the second. That this stage is followed by other after-phases is highly probable, and, consequently, certain results obtained by Wolfe, in the researches into sound-memory for which he employed a method of precision,[2] allow of an easy explanation through the assumption of oscillation in acoluthic auditive sensations, a fact to which he draws attention at page 24 of his work.

So far as I know no study has been made of the total extinction of tactile sensations.

Here again all that is known with certainty is the duration of the average of intensity. Mach[3] by means of a cog-wheel determined the intervals of time between successive stimuli applied to a finger and resulting in continuous sensation. These intervals, he found, measured a little less than $\frac{3}{100}$ of a second. Of course here also the duration of the average of intensity is incomparably shorter than the time required for full extinction.

Owing to purely technical reasons, unexceptionable data regarding acoluthic sensations in taste and smell

[1] I myself could hardly undertake this investigation in any calculable time; but I should be glad if the experiment could be made with the methods above described or, it might be, with better ones.

[2] H. K. Wolfe, "Untersuchungen über das Tongedächtniss," Wundt's *Philsophische Studien*, 3 Bd., 1886.

[3] P. 130. E. Mach, "Untersuchungen über den Zeitsinn des Ohres," *Sitzungs bericht d. math. naturw Klasse d. Akad. d. Wissensch.*, Wien, 51 Bd., II Abt., 1865.

have not yet been obtained. We cannot, however, exclude the possibility that gustative matter is retained by the papillæ of the tongue, or that fragrant particles remain within the cavities of the nose and neighbouring parts. It thus happens that exactly in the region where acoluthic sensations seem easiest to observe, which have indeed furnished ordinary parlance with the word "after-taste," in the chemical sense we turn out to be lacking in any satisfactory proofs regarding these phenomena. All the same we have no reason to suppose that other facts come into play than those which prevail in sensations of sight, hearing, and touch.

In his admirable contributions to the physio-psychology of the sense of taste, Kiesow[1] has given us a number of considerations relating to "after-taste," and I do not doubt that in these researches he had before him, to a great extent, true acoluthic sensations. But there is no absolute statement to this effect in his works, and until some unexceptionable method of research is found, and thereby an accurate knowledge of the duration of these acoluthic sensations reached, we must be content with a mere reference to such "after-tastes." In a like manner we must treat of sensations of temperature and pain, since here again we have no precise knowledge of the duration of their acoluthic effects. These lacunæ are attributable in part to technical difficulties, in part to the slight amount of interest aroused hitherto by all spheres of sensations other than those of sight and hearing.

One concluding remark I must make. The rapid fall in intensity of acoluthic sensations once its highest point has been reached and the relatively quick extinction of these sensations in general are facts of great importance for the undisturbed reception of the subsequent inseparable sense-impression, and constitute an inevitable condition for preventing a new sensation being interfered with by its predecessors during their acoluthic stage. As matters stand it is thereby provided that synchronous sensations

[1] Kiesow, "Beiträge zur physiol. psychologie des Geschmacksinnes," Wundt's *Philosph. Studien*, 12 Bd., 1896, S. 275–8.

do as quickly as possible overcome the acoluthic phases of their forerunners. Under ordinary circumstances we are thus enabled to see, unconfused by the dying down of previous sensations or by their after-images; and the same is the case with hearing and our other spheres of sense; although in exceptional cases a disturbing effect may be produced by these after-images. On the other hand, it is necessary that the acoluthic phase should not be overmuch abridged, for, as we shall see in our next part, it is essential for the successive connections of our store of engrams, as well as for what we habitually describe as successive association. Therefore both rapid decline of intensity from its highest level and the relatively long persistence of acoluthic excitations and sensations before total extinction are fundamental conditions for the life of our sensations in the present stage of their development.

PART II

SEVENTH CHAPTER

MNEMIC SENSATIONS. EXTINCTION OF ORIGINAL EXCITATIONS AND SURVIVAL OF THE ENGRAM

In the foregoing preliminary chapter we have learnt to know the nature of original sensations, their course in synchronous and acoluthic phases, and their mutual relations. We saw them enter on their synchronous phase and rapidly attain the temporary maximum of intensity, and then, entering on their acoluthic phase, die away with a less rapid diminution of intensity than the first sudden decrease in it would suggest, and indeed, than one would suppose without close investigation. We distinguished two secondary phases in this acoluthic dying down: one very brief, in which the expiring sensation is still directly manifest in consciousness; the other much slower, during which intensity is so diminished as to require particularly favourable conditions before the dying acoluthic sensation can still be recognized in consciousness.

And when these particularly favourable conditions are presented the acoluthic phase of sensation lasts at best some minutes after the cessation of a stimulus. Sooner or later, however, even this possibility comes to an end, and sensation, as such, is quite over. But the process here distinguished as synchronous and acoluthic phases of sensation does not vanish without trace but, on the contrary, leaves behind it an alteration which, however, is not immediately perceptible. This latent alteration I call an engram (imprint).

The existence of an engram, as has been shown in detail

in *Mneme*, and as the explanations in the following chapter will make clear, is manifested only indirectly through a change in the reactive capacity of the organism ; that is as a definite disposition to generate a particular mnemic excitation.

The engram, then, is a conception which does not force itself directly like a sensation upon our knowledge but arises from the consideration of the phenomenon by means of a highly complex synthesis which, as shown in the first chapter, page 60, is concerned with the initial conception of excitation.

We give this name, "excitation," to a process considered either from its energetic side or indirectly deduced. We call "sensation" the same process directly felt. Consequently, when we come to the conclusion, based on various later experiences, that the process in question leaves traces after its expiration, then such traces are not immediately felt but are indirectly inferred, thereby requiring us to consider them from the energetic, or excitation, side, and it is as such that we are obliged to view them.

It is true that at present we are not in a position to affirm more than that the change left after extinction of the energetic process of excitation must be envisaged as a change of the stimulated "substance," that is, a *substantial* or *material* change. To follow this into the molecular field seems to me (as I have already explained in *Mneme*) a hopeless undertaking at the present stage of our knowledge; and for my part I renounce the task.

A great number of facts testify to engrams left by every original excitation, even when that has not manifested itself in superliminal sensation. When, therefore, this engram results in the ecphory (emergence) of a mnemic excitation, such as is incapable of manifestation in superliminal sensation, then such a phenomenon does not come into the plan of the present work, which is devoted to the study of superliminal sensations, and we need not deal with it. For in the case mentioned superliminal sensations enter neither into the original process

nor, of course, into the engram nor finally into the mnemic phenomenon. But it happens, nevertheless (as everybody can easily observe for himself), that a past original excitation independent of lucid superliminal consciousness can yet leave an engram which, when evoked into life (*ecphorized*), will produce a mnemic sensation in consciousness. The best example of this is the striking of a clock, not noted at the moment of its occurrence, and therefore not received into superliminal consciousness, but which yet (as we have all experienced) after some lapse of time will be mnemically recalled and counted. That this is not merely a result of after-recognition of acoluthic sensations is proved by the circumstance that if these were merely acoluthic sensations they could only become stronger at each successive stroke. Should the acoluthic sensation incident on the first stroke not be exhausted by the time the twelfth stroke and stimulus have made themselves felt, then the strongest acoluthic sensation occurs, and (in the absence of new sensations from further strokes of the clock to overpower it) would steadily, or perhaps intermittently, die down until entirely extinguished. And whether this dying away be steady or intermittent, such a phenomenon is in no way identical with the *reproduction* of (say) twelve strokes immediately experienced as sensation of which the rhythm exactly reproduces the rhythm of the original sensations.

This is an incontrovertible proof that the case in point is not one of acoluthic but, on the contrary, of mnemic sensations; and it is consequently clear that what we have here is a succession of engrams left by a departing excitation unaccompanied by superliminal sensation, but from which a corresponding succession of superliminal sensations can spring (be ecphorized).

Nevertheless a contrary phenomenon can also happen. If an original excitation betrayed by superliminal sensation leaves an engram from which a mnemic excitation, manifesting itself in superliminal sensation, is evoked (ecphorized), then, especially through frequent repetition of the whole process under certain circumstances, a mnemic

excitation can issue from the engram and show itself in superliminal sensation. That occurs when capacities which we have laboriously acquired—that is with full application of conscious sensation—become unconsciously exercised. Such is the case of any woman who has learnt to knit, and performs the work quite subconsciously while her superliminal consciousness is fully occupied with other matters.

Here is a diagram of the process represented by two rows, in which each compartment of one row corresponds to a phase in a division of the under row, but gives each as seen from the other side, so that we can say:

Original Excitation	Engram	Mnemic Excitation
a —	— b —	— c
Original Sensation	Lacuna in consciousness of the same	Mnemic Sensation
a^2	β	γ

(1) There are cases in which a, although not manifested by a^2 above b, not only develops into an objectively provable c, but in which also this c may show itself in the superliminal conscious sensation γ (e.g. after-counting of clock strikings not previously fully present in consciousness). (2) There are cases in which $a\,a$ over $b\,\beta$ does not develop into $c\,\gamma$, but into c alone (e.g. unconscious reproduction of something consciously acquired).

These apparent paradoxes are explicable simply by the assumption that every original excitation, as well as every mnemic one, is present, considered from the sensorial side, even when the sensations in question are not present in complete or superliminal consciousness. So in case (1) the original excitation a is represented,

though only by the subconscious original sensation a and in case (2) the mnemic excitation c has its representative in the subconscious mnemic sensation γ.

And that processes may occur without any superconscious manifestation, as in the second case, and yet depend upon attention is proved by such a fact as the following: A woman knitting with apparent total unconsciousness of doing it during a lively conversation will yet immediately cease from the work when her attention is claimed in a higher degree by some fascinating novelty. In the same way a pedestrian will arrest his steps and stand motionless, forgetting for the moment even to breathe; and this happens not only under the influence of something peculiar, such as fear, but often when only some subject of absorbing interest arises.

I have here only lightly touched upon the theme of subconscious sensations which, in my opinion, require thorough and serious investigation. It cannot be denied, indeed, that such research has hitherto encountered immense difficulties, and that no practical method in regard to it has yet been discovered. In this work we shall deal especially with the cases in which, through the evocation (ecphory) of engrams, superliminal mnemic sensations clearly emerge; and we now turn to a closer study of such engrams and engram-complexes.

EIGHTH CHAPTER

THE SEPARATE ENGRAM AND THE SIMULTANEOUS COMPLEX OF ENGRAMS

IN the foregoing chapter we have represented the engraphic process as if a given isolated original excitation (manifested as a rule by an original sensation) left behind it a single given engram out of which a corresponding mnemic excitation and sensation could be evoked (ecphorized).

This description is certainly not false, but it is schematic, and has now to be corrected by an extension. We shall see that through this extension our understanding of mnemic phenomena in general is astonishingly simplified and facilitated. While in the foregoing chapter we started with the sequence, " Original sensation—engram —mnemic sensation," we have now to ask : Are there in our sensory life any isolated, sharply defined original sensations, and not rather simultaneous complexes of sensation for whose analysis into single sensations we possess no test, so that such an analysis must in most respects be regarded as an affair of intention and convention ?

This question has already been exhaustively discussed in our second chapter (pp. 73–76), and I must ask the reader to review these conclusions as I do not propose to repeat them. I will only reiterate their final result, which was that neither the classification of sensations according to their quality, or even modality, nor according to the locality of their manifestation affords the means of analysing any aggregate of sensations at a given moment —any simultaneous complex—into its elements except

by an intentional process. This is because, as regards consciousness, we are dealing from the outset with a connected, if not entirely homogeneous, unity which, as in the morphological analysis of organic bodies, can be deliberately cut apart before its constituent elements —always more or less arbitrarily defined—can be separated from one another.

What appears to our naïve consciousness at first sight as a simple sensation—say, a spot of colour of such-and-such dimensions, a tone with all its over-tones, a painful pressure on the skin of so many centimetres, or a similarly limited sensation of heat or cold, the so-called "taste" of food (arising from united sensations in taste and smell): all these, as I have already shown in the example of a wall-paper, can almost always be eventually analysed into smaller or simpler elements. We can easily demonstrate that an attempt to separate a simultaneous complex of sensations into its natural components, that is into components which our consciousness immediately recognizes as separable, fails in every concrete case, and that it so fails is a proof of the primary unity of such a complex. Such being the case, the simultaneous complex of original sensations is so far to be considered a unity that its complete disintegration into elements of any kind is impossible.

Since, therefore, we deal not with simple, isolated sensations in a strict sense separable from one another but only with momentary simultaneous complexes of original sensations (as also of mnemic sensations) in their totality, we cannot, strictly speaking, say that a sensation (that is an excitation thus represented) which cannot be disintegrated leaves an engram behind it; we must start from the idea that the resulting totality, the whole simultaneous complex of excitation, works engraphically by leaving behind it a latent change in the shape of a corresponding simultaneous complex of engrams. Briefly stated, there results the following thesis, which I may call *the first mnemic principle of engraphy*: *All simultaneous excitations* (*manifested in our case by sensations*)

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.

Here it might be objected that it is only in rare, exceptional cases that a mnemic complex of sensations, even approximately reproducing in full the original complex, arises from such a complex of engrams. The answer to this is that if as a rule only mnemic fragments make themselves felt in consciousness, yet these fragments represent complexes and not isolated components. But the question, Why a mnemic reproduction of a simultaneous complex is so fragmentary in spite of the basic engram-complex being self-enclosed? is of such great importance for the proper understanding of the initial, mnemic principle that such an answer does not suffice.

We must therefore examine the question in detail, formulating it as follows: If the simultaneous complex of original sensations forms a coherent group whose existence is proved by the engram-complex which it leaves behind it, why on mnemic reproduction does not the whole simultaneous complex re-emerge in the form of a mnemic complex of sensations, instead of there being only loose fragments of the same? That the latter is the rule is shown by the fact that we recall an isolated event, name, or date, of which we say that we are hanged if we can recollect at what time, under what circumstances, and through whom we have heard it.

There is no question here of the reproduction of a whole simultaneous complex of sensations; in such a case that is a clear impossibility. There is yet another case, in which an entire reproduction, though not impossible, is very rare. Suppose we are making a prepared speech, or quoting in some public discourse the utterance we have once heard of some authority. If our whole attention is fixed on the required process of reproduction the circumstances engraphically latent in our minds cease to co-operate and our speech is directed simply by a pre-

forged chain of separate mnemic sensations, for there can be no question of reproducing the chain of entire simultaneous complexes which have been engraphically registered.

Or, again, suppose we are repeating a lecture we have often given before, or we quote a well-known poem, we do this perfunctorily, bestowing on it no special attention, and yet there may recur to us all kinds of experiences connected with its repeated engraphy. But this, again, would only be an affair of fragments, and not a chain of complete simultaneous complexes. How should the superliminal consciousness of the process be possible, since the engraphy may have been contributed to by twenty separate repetitions—repetitions whose reproduc tion would therefore be constituted by the progress and consciousness of twenty separate mnemic simultaneous complexes? It is certain that this never happens.

This obvious breaking-up of a simultaneous complex during mnemic repetition, as shown in the above examples, is the work of three factors, whose share in the process varies as between themselves. First, there is the usual remarkable fading in the presentation of mnemic sensations as compared with original ones. Next there is the isolating process of attention to which both forms are exposed. Thirdly, there are the peculiar conditions brought into play by mnemic homophony.

The fading of mnemic sensation compared with its original predecessor is one of the best known and most easily demonstrated phenomena. When speaking of both sorts of sensation we are accustomed to say that the mnemic ones are not only faint and shadowy in comparison with the stronger original sensations but that they are also full of gaps and poorer in distinguishing marks as well as less consistent and more fleeting. We shall return to discuss in detail the last-named of these three sets of characteristics; at this moment they have little interest for us. For the moment it is with the first set that we have alone to concern ourselves, since the second lot derive certainly from them. The faintness, the

lesser vividness of mnemic, compared with original, sensations, we can demonstrate to ourselves at any moment by taking an object, say, one's own hand, looking at it attentively for a moment, then shutting one's eyes and recalling, that is mnemically feeling, it; or by striking a chord on the piano and remembering it after it has ceased. In these experiments, as will be seen in our twelfth chapter, the two kinds of sensation are made by peculiar factors of orientation to enter into sharp and exaggerated contradiction with one another; and our experience in dreams, in hypnosis and suggestion, as well as in many pathological cases, teaches us that mnemic sensations under many circumstances can assume life-likeness. But the fact sufficient for our present purpose is that mnemic sensations normally and under equal conditions always appear much more shadowy than original ones. We feel them as distant and hazy, and that is all that need be said on the subject for the moment.

We must now point out that even in a simultaneous complex of excitations every single excitation, though undeniably present, does not manifest itself in superliminal consciousness, but only such a part of that complex as has either been particularly emphasized or been the object of special attention.

If, for instance, while sitting at my writing-table, I look at some object in front of me, I become aware not only of it but of other objects in its neighbourhood, provided that they are not more than 45° outside my range of vision. I only become superliminally conscious of those beyond that distance when directing my attention and my eyes to their periphery (given, of course, the same direction of the sight-axes). I then discover that I get quite tolerably clear images of other objects which are about 90° towards the temples outside my axis of sight. The excitations of the sensitive substance now manifested were necessarily present before my attention was directed to the periphery, but the conditions for superliminal sensation were lacking. Moreover, the sensa-

tion of a peripheral object can be lifted above the threshold of consciousness not only through attention directed to the periphery but also on an increase of strength in the excitation following on a reinforced stimulus. We do not notice a lamp placed beside us unless it is burning. Once lighted it engages, *cæteris paribus*, a large share of our conscious optical sensations. The original excitations composing a simultaneous complex must then in any case attain to a certain vividness before they can manifest themselves as portions of the content of sensation; and this is true not only of original, but also of mnemic excitations. But if as a rule every simultaneous complex of original excitations is only reproduced mnemically with decrease of vividness, it follows naturally that out of the collection of lively excitations which formerly expressed themselves in original sensations a very much smaller contingent of the most impressive ones are manifested in mnemic sensations. Only complexes at their highest degree are carried over the threshold of superliminal consciousness and present themselves as "associated" islands of consciousness, just as the towering summits of the Alps could appear as independent peaks if the level of the neighbouring sea rose to 3,000 metres. Or, let us take another comparison. Suppose we possess one print of a photograph which renders most of the delicacy of the negative. This shall represent the original sensations. But in addition we have blurred proofs which recognizably exhibit only the details which are most contrasted with one another. In a photograph of persons in a room, for instance, we see only a number of faces appearing through a mist with perhaps here and there a clearer hand or particularly well-reproduced piece of furniture, such as a mirror or a bright picture in a dark frame on the wall. But no connected whole is distinguishable, and the faces, hands, mirror, and pictures seem thrown together helter-skelter. Quite similar to this is the mnemic reproduction of a simultaneous complex of sensations, with the difference that this complex is constituted not only by optical, but also by auditive,

gustatory, olfactory, tactile, organic, and motor sensations reinforced or not by feeling, tone, or "affective quality."

Out of all these different constituents mnemic reproduction gives us merely at best a fragment of the most important components, and these fragments we speak of as "associative." But 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.* As a matter of fact we are able in most cases, if with some trouble and study in respect of the simultaneous complex, to disengage many details from the fog through which peer these associated peaks and, finally, to evoke (*ekphorieren*) the former complex of sensation, at least in its fundamental features.[1]

But while making this deduction from the force of the word "association" I propose all the same to make use of it, as it is too rooted in habit and too convenient to be easily abandoned, as well as not being easily misunderstood when taken *cum grano salis* or, in other words, when there is full recognition of the truth that what we have to deal with is no combination of isolated facts but a connected whole, the stored and partially faded reproduction of one fundamentally unified simultaneous complex.

If the general loss of vividness in mnemic reproductions of original simultaneous sense-complexes usually results in only the peaks of sensation in all spheres of sense piercing through to our superliminal consciousness, the faultiness of a mnemic representation is also often increased through our attention being attracted by only one summit or one group of summits—an effect due to the lessened vividness of mnemic sensations as such. We certainly perceive the soaring peak more clearly, but its partners, owing to this momentary diversion of our attention, naturally sink to the level of our subliminal consciousness. What occurs is similar to the case of a simultaneous

[1] In *Mneme* (2 Aufl., S. 123) I have exemplified this fact in detail.

complex of original sensations which has been already mentioned (see p. 162). But the greater distinctness of such original sensations prevents this attenuating effect of the failing of attention from being as great as when the sensations are of a mnemic nature. It is therefore obvious that if we direct our whole attention to reproducing the tones of a scale all the details of the situation in which we found ourselves at the former hearing of the same, and which under ordinary circumstances would immediately recur to our memory, must now sink in to the subliminal circumstances. 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.

A further hindrance to the complete reproduction of a whole engram-complex arises, as we have mentioned, from the peculiarities of mnemic homophony. This is a point to which we shall return in detail later. For the moment the following example must suffice. Suppose I have learnt by heart a poem after reading it out loud some twenty times under varying circumstances; that is to say I have thereby produced twenty engrams of the poem, which on reproduction appear as a succession of homophonous mnemic unities of which the sensations will emerge homophonously. Yet the remaining portions of the twenty engram-complexes are all essentially different, since I have sometimes repeated the poem to myself of a morning, sometimes of an evening, sometimes when alone, sometimes in company, sometimes in one room, sometimes in another, a third time in a garden, and yet none of these diversities will emerge homophonously, or be felt as coexistent. Each will compete with another for the upper hand.[1] Consequently, if my whole attention is not fixed on the poem when repeating it I shall recall at most a scrap here or there of the non-homophonous components of the twenty engram-complexes at the same time as the homophonous elements of the poem itself.

[1] For further particulars on this point see the eighteenth chapter.

Having by this time learned why a simultaneous engram-complex, produced and preserved as a whole, yet is able to manifest itself only fragmentarily in superliminal mnemic sensations, we must now make a most important addition to the question of this simultaneous complex. For the sake of simplicity we have hitherto assumed that a simultaneous sense-complex represents an aggregate, at a given moment, of all original sensations; that it is, as such, a connected whole, and that the excitations which these sensations prove act engraphically as a connected whole and produce a simultaneous engram-complex. This entire assumption is founded on the fact, fully explained at pages 73–76, that it is impossible to dissolve a simultaneous sense-complex into its natural elements. But does such a complex consist entirely of original sensations? That is true only of the simultaneous complex of new-born animals and humans.[1]

A human being who has reached a certain, not very advanced, age, has certainly no simultaneous engram-complex into which numerous mnemic sensations do not enter in connection with the original sensations to which their own ecphory is due. Now, do these mnemic sensations in the simultaneous complex behave differently to original sensations—that is can they be separated otherwise than arbitrarily from the totality formed by the simultaneous complex?

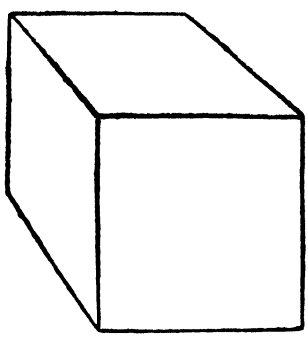
That there can be no cut-and-dried separation of mnemic sensations from the original complex is proved by the following example.

If we show the accompanying figure to an unprejudiced person he will take it at once for a cube. If required to see in it only a planimetric figure, that is a square accompanied by two trapezia, then, particularly if he is unaccustomed to geometrical conceptions, he will nearly always find it difficult to shake off the belief in a solid body and only to see a figure of lines on the flat. If when

[1] But only for them when we ignore mnemic sensations springing out of hereditary engrams. As stated in the preface, the consideration of these is reserved for a future work.

the planimetric figure has been at length perceived and the subject ceases to look at it for a while, on returning to it he will usually again see it as a cube, and this will happen in spite of the flat surfaces of the figure showing no sign of the shading which is never absent from the flat surfaces of a real solid, and although the outlines are entirely free from the effects of aerial perspective.

The linear figure, whether looked at with one eye or both, resembles but summarily and defectively the image we perceive on looking at a real cube, still the resemblance



is sufficiently strong to cause the ecphory of the solid cube's engram and correspondingly to transform the original sensation of a mere two-dimensional drawing.[1] In this and, as we shall see later, in numerous other cases it is quite possible for an attentive mind to separate

[1] Such an intimate union of original and mnemic sensations is described by Wundt (*Grundz. d. phys. Psych.*, 3 Bd., 1903, S. 528) as "assimilation," and defined as follows: "It takes place when earlier elements are renewed through the entry into consciousness of a new image, thus causing the former to unite with the latter in one simultaneous whole." Wundt again describes as "complication" (*ibid.*, p. 541), herein agreeing with Herbart, the "union of images and feelings in different spheres of sense." Whether it be necessary or of practical use to distinguish and describe under special terms these intimate connections occuring within a complex of sensations is a point I will not try here to settle. Anyway, the present investigation of fundamental mnemic phenomena does not call for the use of such terms.

mnemic from the corresponding original sensations. But there are circumstances under which such a separation is unattainable, no matter what degree of attention be applied to the trial.

The regular presence of mnemic sensations, i.e. excitations, in every simultaneous complex and their intimate connection within the latter with original sensations is of the greatest importance for the efficacy of engraphy in the sense of our first mnemic principle. This we learn continually by experience For instance, the person who sees a solid cube (cf. pp. 66–67) instead of a planimetric figure has in that moment become possessed of the engram of a cube, that is to say not only the original but also the mnemic components of this complex have worked in him engraphically and will be ecphorically reproduced. His memory on that side will ever more recall the image of a solid cube and not of a planimetric drawing.

Further, and yet more convincing examples will be given in different places further on; see more especially a case mentioned at pages 165–6.

As a matter of fact, in everyone after early childhood nearly every complex of original sensations has grouped around it numerous mnemic sensations which are evoked by it and work engraphically in the grouping. The important consequences of this fact will be explained in detail further on. At the present stage of our investigation we have only to show that every simultaneous complex of sensations is composed of original and of mnemic sensations which are closely connected with one another, and thus form a whole;[1] and this whole—regarded from its energetic side—works engraphically.

[1] In sleep, in deep meditation, and similar states, original sensations may be greatly in abeyance; but it is probable that they are never entirely without effect.

NINTH CHAPTER

THE INDIVIDUALLY ACQUIRED STORE OF ENGRAMS

I REFER to an individually acquired store of engrams in contradistinction to an inherited store. On the latter I will not now dwell, as we are here interested only in the engrams out of which superliminal mnemic sensations can spring, and because it is, at least, doubtful whether inherited engrams can produce such superliminal sensations with any distinctness. In any case, I eliminate that question from my present line of research and reserve its thorough examination for a later opportunity and in another connection. For a survey of inherited stores of engrams see *Mneme.*[1]

From the beginning of individual life to its close, the sensitive substance of each being is subject to an increasing current of different excitations of which only a certain portion is manifested by superliminal sensations. We do not need here to go into the difficult question of the stage in individual human developments at which it can be said that superliminal sensations begin to exist. Excitations are reeled off in the life of the individual like threads from a distaff. It is true that each has a beginning and an end, but appearance and disappearance happen for this component at one place, for that at another, so that the whole presents a perfect continuity. The continuity in the case of flaxen or woollen threads is one of space; in that of complexes of excitation it is one of time.

As to the possibility of analysing the elements of the

[1] *Mneme*, 2 Aufl., SS. 152, 276, 281, etc.

current of excitations, I expressed myself in *Mneme* as follows:[1] "We described the arrangement of the simultaneous excitations and their annexed complexes of engrams as constant, serial, and similar. In the expression 'constant' lies already the affirmation of a continuity which admits of no disintegration, although in thought we assume a disintegration which is foreign to the phenomenon itself. This becomes clear when we try to define disintegrated portions. If we are speaking of simultaneous excitations, that is excitations which are present in consciousness at the same moment, and the question arises, How long does the simultaneousness last? the enormous number of impacts at each moment on our organism, each of which begins and ends at its own time, allows us to answer only, 'an incalculably brief time.' But as every process of excitation in our organic substance, even the briefest, must take a measurable time—in other words, is never incalculably brief—it follows that the sequence of simultaneous and apparently unmeasurably brief moments of time is simply a logical separation introduced into our conceptions from the outside."

To avoid misunderstandings I would add that the concept of a simultaneous complex in regard to its separateness from predecessor and successor is also the product of an arbitrary distinction, but that the simultaneous complex so extracted when regarded as an infinitesimal of time forms a natural unity.

The sequence of simultaneous excitation- and sensation-complexes presents itself to our minds as a process in time, that is to say that when the simultaneous complex O appears N is already over and P has not yet come forward. As we have seen, simultaneous excitation-complexes leave engram-complexes behind them, and out of these mnemic excitation-complexes, corresponding to earlier excitation-complexes, may be ecphorized. These engram-complexes left by excitation are enduring in contrast to the temporary nature of their parent sequences,

[1] 2 Aufl., S. 130.

for while the simultaneous excitation-complexes, *n*, *o*, *p*, follow one another in time, the corresponding engram-complexes, n^2, o^2, p^2, arise all together; that is to say we can summon forth, all at once, any store of simultaneous engram-complexes which yet belong to quite different periods of time. I would draw attention to the fact that by a simultaneous excitation-complex we must understand something which simultaneously *exists*, and by a simultaneous engram-complex something which simultaneously *arises*. To introduce this distinction into our terminology would be, however, too complicated, as every intelligent reader silently—mnemically—makes it for himself.

From the outset of individual life every simultaneous excitation-complex leaves behind it an enduring change in the corresponding engram-complex. The engram is a lasting, latent change in the organic substance.

In the fifth chapter of *Mneme* I discussed the question whether and how far this change may be localized in certain portions of the individual's sensitive substance and I concluded that a gradual, but not exclusive, localization is to be assumed for the individually acquired engram. I leave this point for the present, and will return to it in detail at a later stage of the inquiry.

Every moment of individual life adds something to the already existing sum of simultaneous engram-complexes. As its origin betokens, our individually acquired store of engrams is always at our disposal in chronological strata. This follows necessarily on the circumstance that every simultaneous engram-complex is inwardly for ever bound up with its predecessor and successor. We shall inquire farther on how this fact is itself to be explained. So far, we have only to note the chronologic stratification of the individually acquired store of engrams; at all events such an arrangement seems to be revealed by manifestations of mnemic excitations (i.e. mnemic sensations) in this engram-store. This does not, however, at all imply that the alterations of the organic substance which we are obliged to conceive, however hypothetically,

as being somehow the morphological substratum of engrams and engram-complexes are (i.e. the organic alterations) deposited in morphological strata. For we are at present quite in the dark as to the special morphological nature of that surviving alteration in organic substance which we call an "engram." Equally little are we able at present to describe the mutual morphological relations of two successive engram-complexes, although we can come to a conclusion as to their *functional* relations, in other words, as to the ecphoric action of an engram, called forth by mnemic excitation, upon a differently constituted successor. In short, when we speak of chronologic stratification in the separate simultaneous engram-complex of an individual engram-store, we have to understand the description as *figurative*, and not as literally conveying the spatial arrangement inside the organism of the stored-up engram, about which, as I have already said, we are utterly ignorant.

The several components of each engram-complex are arranged within that complex in precisely the same relations to one another as the sensations of the original complex to which these engrams are due. Speaking in a previous chapter of the arrangement of such original sensations, we defined it as being a side-by-sideness or discrete coexistence (pp. 77–86). In a forthcoming chapter on the ecphoric value of components, we shall deal more precisely with certain relations of the components of a simultaneous complex inside each separate complex and in the series of stratifications.

We have now to return to a highly important and characteristic feature of the individual engram-store and the simultaneous complex which builds it up. For simplicity's sake in the foregoing explanations we have presented our subject so that the simultaneous excitation —that is sensation-complex which we regard as the parent of the simultaneous engram-complex—usually appears to consist primarily in *original* excitations, i.e. sensations.

This is, however, an arbitrary simplification. Every

simultaneous excitation-complex includes not only numerous original excitations of all kinds but also very many mnemic excitations, and these constitute an *integral part* of the simultaneous excitation-complex concerned and act engraphically on the new material exactly like excitations newly set up by an original stimulus. Together, therefore, with the mnemic excitations representing the energetic condition produced by original excitations and their original stimuli, we must count all the mnemic excitations which happen to be ecphorized at the time, and which join with the rest as factors of further engraphy. As already mentioned, a clear distinction between original and mnemic components within a simultaneous excitation —that is sensation-complex—is as little to be made as in the case of original components. A simultaneous complex in respect to all its elements constitutes therefore a combined whole, and as such acts engraphically. When through ecphory, as we have learnt to know, the highest peaks of sensation alone emerge, mnemic and original distinct elements appear as what we call "associated"; and this association is, of course, inherent in the essential unity of every simultaneous excitation, i.e sensation-complex.

But as the mnemic components of such a simultaneous complex may be drawn from all the previous strata of an individual engram-store, and can be re-combined among themselves and with original sensations actually existing, I gave to the phenomenon thence resulting the title of "constructive association."[1] But while this expression illustrates fairly well the phenomenon just described, it has the disadvantage of creating certain difficulties of classification. Hence I prefer to substitute for it the rather ponderous title, "Association of components of different strata of engrams."

I now proceed to illustrate the interweaving of the components of older engram-strata with younger ones or, what amounts to the same, to show how through simultaneous ecphoric action engrams of which the

[1] *Mneme*, 2 Aufl., SS. 148, 357.

original causal excitations belonged to quite different times can eventually become associated.

I enter the reading-room of an hotel and find that, like yesterday, the latest copy of the newspaper which I like to read at breakfast has, the first thing in the morning, disappeared. Probably it has already been confiscated by the easy-going and phlegmatic party who yesterday morning never again laid it down. Immediately there rises in my mind the image of another equally cold-blooded newspaper-devourer who, when I was last in Switzerland, ten years ago, similarly exasperated me. That individual was short, this one is tall; the former was a crafty Saxon, the present one is an honest Bavarian. I wish that they might once be in the same hotel, for then they could tear each other to pieces with the same weapons. In a few seconds all this flashes through my mind, and immediately afterwards my sensuous life is under the influence of quite another set of impressions.

But from that hour the engrams of these two persons, belonging, one to the stratum of to-day, the other to a stratum laid down ten years before, are for me as intimately associated as if I had seen them together in the flesh, as if their images had formed the original stimulus in the same simultaneous complex. In a word, the elements of the original, as of the mnemic, components of a simultaneous complex become associated. Since through simultaneous ecphory every kind of element of our whole individual store of engrams can be absorbed into an actual complex of sensations, similarly any kind of element of our individual engram-store can at any later time be united with any other. Fundamentally, this power of association is due simply to the simultaneous ecphory of engrams entering into new combinations; but this peculiarity forms the starting-point of the highest achievements of which the sensory organism on its so-called "spiritual" side is capable.

Only a few highly developed animals share this faculty with man to any notable degree, and that in much-diminished measure.

The reason of this is that only a highly developed organism can evoke the engrams belonging to different strata of the individual engram-store and unite them in new combinations. I cannot enter here into details but I hope to do so in another connection. For the moment I will only state the fact that *the highly developed human creature is able, through the simultaneous ecphory of engrams from different engrammic strata to combine afresh every element of his individual engram-store with every other, and thus to form innumerable novel combinations of engrams.*

We must here pause a moment and ask ourselves: How are new combinations arranged in the individual engram-store? Or—only to take the very simplest case which yet furnishes the key to much which is very difficult in an intricate subject—what happens when the same mnemic sensation becomes the component of a different simultaneous complex through the repeated action of ecphory? Let us assume that the original sensation *d* (or) is a component of the complex *b* (or), *c* (or), *e* (or), *f* (or), and becomes, of course, simultaneously associated as engram *d* (engr) with its joint components *b* (engr), *c* (engr), *e* (engr), *f* (engr).

Through a later three-fold ecphory of the engram *d* (engr) this component enters as a mnemic sensation into three other later-developed simultaneous sensation-complexes as under:

1st	*i* (or)	*k* (or)	*d* (mn)	*l* (or)	*m* (or)
2nd	*q* (or)	*r* (or)	*d* (mn)	*s* (or)	*t* (or)
3rd	*w* (or)	*x* (or)	*d* (mn)	*y* (or)	*z* (or)

The result is that thereafter the engram *d* (engr) figures in our individual engram-store as a component in the four following quite different simultaneous complexes:

Complex F	*b* (engr)	*c* (engr)	*d* (engr)	*e* (engr)	*f* (engr)
Complex K	*i*	*k*	*d*	*l* (engr)	*m* (engr)
Complex P	*q*	*r*	*d*	*s* (engr)	*t* (engr)
Complex U	*w*	*x*	*d*	*y* (engr)	*z* (engr)

Or expressed verbally and illustrated by an example: The original sensation is that of a striking-looking fruit

containing many components of sensation, and seen by me but once. In Torbole, in a November garden, I saw some trees bare of leaves, but apparently covered with reddish-yellow flowers. On looking closer I found that these supposed flowers were fruits, and the gardener who plucked and gave me one to look at described the tree as the Japanese-Chinese *Diospyrus-kaki*.

This simultaneous complex of sensation deposited the engram-complex F. Years later, under quite other circumstances, the image of that fruit returned vividly to my consciousness when at an evening party a question arose as to the most suitable colour for uniforms, and *khaki* colour was designated as the best for uniforms in the tropics.

"That colour must be much less brilliant," I thought, "than the fruit of *Diospyrus-kaki*"; and for a moment I saw again the garden, trees and fruit of Torbole.

Another time, much later, when in a railway station I heard a traveller ask for a ticket to Nago-Torbole. The month happened again to be November, and I wondered would some chance take the traveller to that garden with its strange trees and their seeming flowers. Finally, I was reminded of the same thing once again, as the waiter at a restaurant offered me ices made to look like fruits, one of which in colour, size and form, closely resembled the *Diospyrus-kaki*. I consequently have now four separate engrams of this fruit, each one completely determined by the fact of belonging to a different complex of my individual engram-store, and being intimately bound up therewith.

What happens, then, when in my study, walking up and down I re-evoke the image of that fruit?

My consciousness retains one special image, but accompanying it are mnemic sensations, certainly of a much weaker kind and of varying vividness, which recall sometimes the garden, sometimes the evening party, sometimes the railway-station, sometimes the restaurant table-d'hôte. These sensations can be to the last degree faint; and while at times one, at times the other, gains the upper

hand, they may be occasionally partly combined. And I am only able to see the fruit as entirely free from them when fixing my attention on it exclusively. Each engram-complex to which the engram of the fruit adheres is then a fixed unity in which through ecphory one mnemic sensation may be especially strong while the remainder are weakened, but which yet forms a continuous whole, like a picture of which one corner may be brightly illuminated while the rest is more or less in darkness.

To return to our first alphabetic conception of the problem, we say that the ecphory of fruit-engram *d* (engr) in the engram-complex F K P U produces contemporaneously the four following mnemic sensation-complexes :

F	*b* (mn)	*c* (mn)	**d** (mn)	*e* (mn)	*f* (mn)
K	*i* (mn)	*k* (mn)	**d** (mn)	*l* (mn)	*m* (mn)
P	*q* (mn)	*r* (mn)	**d** (mn)	*s* (mn)	*t* (mn)
U	*w* (mn)	*x* (mn)	**d** (mn)	*y* (mn)	*z* (mn)

Particular attention directed to the component *d* (mn) causes all other components of the sensation-complex to recede into the background.

The strongest sensation of all is evoked by the complex F, because this is the manifestation of a very powerful engram following on an original stimulus ; and in the above schema all this is indicated by types of various size.

But when in reality the engram *d* is not alone ecphorized, but each of the four engram-complexes, F, K, P, U, spring up in a whole of which the elements vary in intensity, it follows that in this new sensation-complex the mnemic sensation *d* (mn) is not once but four times present. It is true that these four sensations reach our consciousness in a united form of sensation, and consequently the idea of a fourfold presence of *d* (mn) might be dismissed as a mere refinement of analysis. But in the chapter which treated of the homophony of original sensations we found a somewhat analogous case, and in later pages, when discussing mnemic homophony, we shall have an opportunity of demonstrating on a wider field and from numerous facts the correctness of our

present deduction. Then we shall see that we are here dealing with phenomena of fundamental importance, the correct understanding of which throws a flood of light on many sides of our conscious life. So far, however, we have established the fact that each ecphory of an engram produces not only a mnemic sensation, that is excitation, but through this creates a new engram which adheres to the new engram-stratum.

Each ecphory thereby produces indirectly new combinations at the very least with the engrams of the new original components of a complex through the simultaneous ecphory of engrams belonging to different strata of engrams, and also causes new combinations of mnemic components differing among themselves in origin.

We have thus far completed a survey of the nature of a simultaneous complex of engrams and its relation to the individually acquired engram-store. Important additions to our theme will be made in the tenth, eleventh, seventeeth, and eighteenth chapters.

TENTH CHAPTER

ECPHORY AND THE DIFFERENT FORMS OF ASSOCIATION

IN my book *Mneme* I devoted a special chapter to Ecphory in which I reviewed the development of every sort of engram from its condition when latent to that which it assumes under mnemic excitation, whether the manifestation of this excitation be due to motor or plastic phenomena, to metabolism or to conscious (sensory) reactions.

Although I conclude that many readers of the present work may have made themselves acquainted with, at least, the chief features of the previous one and I might, consequently, spare myself repetition, yet I propose to recall various passages relating to ecphory, inasmuch as I hold them to be of primary importance for my special theme, which is the sensory manifestations of excitation.

The ecphory of an engram should be understood as being its passage from the latent to the active state or, in other words, the arousing of a condition of excitation (= sensation), which has remained as a permanent, though locally dormant, alteration in the sensitive substance of an organism. The engram thus aroused or the excitation caused by it, I call a *mnemic* excitation, and its manifestation I describe as a *mnemic sensation.* As will be better explained later on, we have no reason to suppose that the mnemic sensation as such is different in consciousness from its predecessor, the original sensation. Setting aside the circumstance that a mnemic sensation in general requires for its manifestation to be preceded by an original sensation (although by an

original excitation which need not always be manifested in sensation), consequently that there exists between the two the relation of a one-sided (not reciprocal) influence, the difference between them lies in the requisite condition for their production.

The original complex of sensation is produced and held together through the action (synchronous with sensation) of a stimulus-complex, which we call an original stimulation. The corresponding mnemic sensation-complex requires for its production and maintenance not the complex repetition of the stimulus-complex but a very much slighter impetus which I describe as ecphoric. I have already given the meaning of ecphory in the following definition (repeated from *Mneme*), which covers the subject of *Mneme* to its full extent and is not limited to the mere narrow recollection which must fail in every concrete case. This definition which I call the second mnemic principle, or the ecphoric principle, is as follows : *The partial return of an energetic situation which has fixed itself engraphically acts in an ecphoric sense upon a simultaneous engram-complex.* As already explained in *Mneme* [1] we have to understand by " energetic situation " not only the influences working from outside upon an organism but also its inner energetic condition taken in the widest sense. We might further elucidate the above definition by adding that the partial return of an outer, as well as of an inner, energetic situation acts ecphorically.

And as regards our special point we can express that by saying that " Not only can an engram-complex be recalled to activity (*ekphoriert*) by the partial return of the stimulus which produced an original excitation-complex, and thus created an engram-complex, but the 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.

A still more precise mode of expression and further specialisation of what is essential for our treatment of

[1] 2 Aufl., S. 122.

the phenomena in hand can be gained by substituting for "outer energetic situation" or "original stimulus" that which these produce in the sensitive substance, the particular products called "*original excitations.*"

And instead of "inner energetic situation" in so far as this represents a state of excitation of the sensitive substance independent of original stimulation, which is all that our essential treatment of the subject demands, we may use the words "*mnemic excitations.*" With this refinement our second mnemic principle would run in this wise: "*An ecphoric effect upon a simultaneous engram-complex is obtained by the partial return of the excitation-complex which on its side has deposited an engram-complex, and this return must take the form either of original excitations* (produced by an original stimulus) *or of mnemic excitations* (produced in the second instance by a mnemic process).

We have seen that every simultaneous excitation- (= sensation-) complex forms a combined unity, and as such acts engraphically, leaving behind it a simultaneous engram-complex. In order to achieve the ecphory of this engram-complex and its expression in a corresponding mnemic sensation-complex, a partial return of the conditions which called forth the simultaneous sensation-complex is alone required.

Let us borrow from *Mneme* a reiterated illustration of a simultaneous complex in the following list of original sensations: A view of Capri, a tune played on a barrel-organ, a special smell of oil, a hot sun, and shoes pinching after much walking—all these will be engraphically registered; and the return of the same smell or one much like it will suffice to call forth the whole engram-complex and to change it from its latent state into a mnemic excitation- (= sensation-) complex. All this follows the wording of our second principle thus formulated: "The return of *one* component of a former simultaneous complex of sensations, that is to say the *partial* return of this complex, starts into activity all the remaining

components, in other words, the whole original simultaneous complex in the form of mnemic sensations."

For reasons already fully explained (pp. 162–66) such an ecphoric process rarely brings back to our consciousness the whole of a former simultaneous complex. Only the summits of a sensation-complex clearly reach the superliminal consciousness. All the fainter sensations which because of their faintness have been to a less degree engraphically deposited, also all those to which attention had been less directed at the moment when ecphory took place, float in the mist of subliminal consciousness, and only under special conditions, particularly when attention is fixed upon them, do they reach—and then only partially—the upper regions of our memory. Consequently, it would seem that those summits of a simultaneous complex which ecphory alone reveals with clearness—as, for instance, the vision of Capri and the smell of oil—are closely connected and are specially associated.

And when we have to deal with a concrete case, as for instance that of a former simultaneous complex, only the two strongest engrams have survived and can be clearly recalled as mnemic sensations; and, further, that the return of one entails the re-emergence of the other, there is practically no objection to describing the mutual relation of the two as simultaneous association, and to saying that ecphory here is a consequence of such association. Nevertheless, this description should be taken with caution, and we must not forget that we have here, as usual, not two isolated directly connected mnemic sensations but a simultaneous sensation-complex of which only a few of the higher peaks soar into our superconsciousness. On observing more closely and with some assistance[1] we find, perhaps on occasion, that besides the smell of oil and the vision of Capri we become superliminally reminiscent of the barrel-organ tune, the hot sun and the pinching shoes, and that these components act ecphorically when the simultaneous complex is reawakened.

[1] *Vide Mneme*, 2 Aufl., S. 124.

The question, Whether, when the simultaneous complex is re-awakened, each component has an equal ecphoric effect? is one which we will consider when we have explained the principles of successive association and reached the problem of mnemic processes which do *not* recur. This subject will be treated in the next chapter under the title "Ecphoric Quantivalence of Components."

We turn now to the question, Whether our definition of ecphory includes the case of ecphory where the principle of *successive association* is concerned?

We must take it as established—although exact experiment has hitherto been limited to the sphere of optics and acoustics with only transient observation of the tactile sense—that every sensation (or its forerunner, excitation) survives the causal stimulus to a sensible degree. The survival, it is true, is accompanied by an important decrease of intensity,[1] but it enters in its acoluthic phase into a whole sequence of subsequent simultaneous complexes and, although necessarily with the diminished strength following on decreased intensity,[1] does finally leave behind it a recognizable engraphic trace.

Fundamentally this statement avails for every original sensation (= original excitation). We will later draw the consequences ensuing for the construction of a simultaneous engram-complex, and with the simplified example of a succession of separate extremely simple sensations, we will demonstrate the importance, engraphically regarded, of the fact that every original sensation (= excitation) has not only a synchronous but also an acoluthic phase.

Let us suppose that a sequence of light-stimuli (stimuli from light) act upon us quite discontinuously from subsequent stimuli coming one after the other. These sequences of stimuli elicit a discontinuous sequence of synchronous

[1] I use the word intensity in its wider sense to include the diminution determined by the strength of a stimulus as well as the loss of vividness usually accompanying this diminution but to be specifically distinguished from it.

optical sensations, C (syn), D (syn), E (syn), F (syn). But now the synchronous sensation C (syn) falls in with the acoluthic sensation *c* (ac) or, if we take account of the diminishing intensity from one moment to another, with the sequence c^1 (ac) — c^2 (ac) — c^3 (ac) — O (ab).[1] The synchronous sensations D (syn), E (syn), F (syn), behave correspondingly. The following schema [2] explains the coincidence of the synchronous phase of a sensation with the acoluthic phases of its predecessors:

PHASES

1	2	3	4	5	6	7	
C (syn)	—c^1 (ac)	—c^2 (ac)	—c^3 (ac)	O			
	D (syn)	—d^1 ,,	—d^2 ,,	—d^3 (ac)	O		
		E (syn)	—e^1 ,,	—e^2 ,,	—e^3 (ac)	O	
			F (syn)	—f^1 ,,	—f^2 ,,	—f^3 (ac)	—O

It will be seen that there is simultaneousness between the synchronous sensation D and the acoluthic c^1 (ac), then again between the synchronous E and the acoluthic d^1 (ac), as well as with the now very weak c^2 (ac); and finally between the synchronous F (syn) and the acoluthic e^1 (ac), the weaker acoluthic d^2 (ac) and the dying c^3 (ac).

Turning now to the engrams which the excitations,

[1] Unexceptionably but unpractically we might write as follows:

PHASES

1	2	3	4	5
C (syn) —	— *c* (ac)	>———	———	——O

[2] Only the components underlined in the schema are felt or "observed" by superliminal consciousness.

as manifested in the above sensations, have left behind them :

COMPLEXES OF ENGRAMS

1	2	3	4	5	6	7
C (engr)	c^1 (engr)	c^2 (engr)	c^3 (engr)			
	D ,,	d^1 ,,	d^2 ,,	d^3 (engr)		
		E ,,	e^1 ,,	e^2 ,,	e^3 (engr)	
			F ,,	f^1 ,,	f^2 ,,	f^3 (engr)

Now, this engram-sequence having been established, if the original sensation, and the original excitation E (syn) manifesting it, were to arise again in consequence of a new original stimulus, then, in accordance with our definition, the engram-complex No. 3, E (engr), d^1 (engr), c^2 (engr), would be ecphorized as a " partial recurrence " of the simultaneous original excitation-complex which has been engraphically registered in the organism.

But secondarily, the engram-complex No. 4, F (engr), c^1 (engr), d^2 (engr), c^3 (engr), would also again be ecphorized, seeing that E (syn) represents in regard to this engram-complex the partial recurrence of the simultaneous original excitation-complex which has been registered in the organism.

The acoluthic excitation e^1 (ac) will also be registered in its turn and leaves behind it the engram e^1 (engr).

But e^1 (ac) is distinguishable from E (syn) only through its diminished intensity, and, setting aside the fact of its small importance, the new original excitation E (syn), whose ecphoric action we are considering, becomes e (ac) through the inevitable decrease of intensity.

As we must assume that all excitations go through not only a synchronous but also an acoluthic phase and, in the latter as well as in the former, leave behind them engrams productive of mnemic excitations which are weaker only because of the diminished intensity of their

generators, it follows that every ecphory of a simultaneous engram-complex, owing to the partial recurrence of the engraphically acting simultaneous excitation-complex, must necessarily entail the ecphory of its successor. So that ecphory also on the basis of *successive* association must be included in our general definition,[1] and in the end represents only a sub-species of ecphory on the basis of *simultaneous* association.

For the rest, we can construct purely mnemic successions of mnemic excitations (= sensations) which act engraphically like original excitations, and consequently construct associated engrams which through ecphory traverse a successive mnemic process. As an example let us take a short poem learnt silently by heart and then recited aloud.

[1] I would here devote a few words to the views of Münsterberg (*vide* "Die Assoziation sukzessiven Vorstellungen," *Zeitschs. f. Psych.*, I, 1890, and also *Beiträge z. exper. Psych.*, 1889–92), who agrees with mine in some points and differs in others. Münsterberg conceives that one, but not the only, way in which successive association works is "that *a* is not extinguished in consciousness as soon as *b* arises, and *b* still is persisting when *c* comes." Münsterberg in this argument has anticipated the fundamental principle laid down by me in this connection. But he has not gone deeply into the subject, and especially has disregarded the physiological fact of the normally regular survival of sensations (= excitations), and therefore has reached the certainly erroneous conclusion that every simultaneousness of sequential complexes can be inhibited by a special experimental arrangement. In my view this is physiologically impossible, and the indirect proof advanced by Münsterberg (p. 105, 1890), and which reposes on a very contestable basis, has no significance.

As regards the second principle on which Münsterberg founds the production, under certain circumstances, of successive associations, I quite admit that engrams of movements and impulses of movements (e.g. the movements of the mouth accompanying verbal images) ally themselves with acoustic, optic and other engrams, and thus prepare a favourable soil for ecphory.

But the combinations of these motor engrams follow the same rules as other engrams, that is, those explained at pages 184–5, and Münsterberg's contrary opinion (p. 100, 1890) has, according to me, no single argument in its favour which cannot be immediately disproved.

The description is exactly the same as for the successive association of original excitations. Every mnemic excitation (= sensation) reproduces the original excitation (to the engram of which it owes its existence) with all its peculiarities, including those belonging to its course in time, and exhibits also the same phenomena of extinction, the same acoluthic phase. Newly combined successions of mnemic excitations must naturally leave behind them exactly the same engraphic structures as corresponding successions of original excitations (= sensations).

According to our definition and from a closer examination of our two schemata, one might expect that ecphory could take place through *antecessive* association, through a simultaneous complex going back to its predecessor, and experiments show that this is possible. But, practically, such an ecphory is of no account, owing to certain peculiarities of the engram-store and consequently of the mnemic process of extinction, and any extinction in inverse direction to the original one from which the engram derives is excluded. We shall explain this more fully in the next chapter.

We have now to devote a few words to other forms of association, which many psychologists distinguish from one another and which can all be referred to simultaneous association. Of old and even in our times, following the example of Aristotle, four different sorts of association constituting two couples, were accepted.

The first couple was association by likeness and unlikeness (contrast); the second was association by coexistence and succession. It is evident that this second pair corresponds to our simultaneous association (coexistence) and to the successive association deriving from it.

As regards association by likeness this conception reposes on a peculiar but widely diffused error due to insufficient definition and to consequent false inferences.

We will make this clear by as sharp a confrontation as possible of the definitions in question, and we will then see where they went astray and mistakes arose.

We have defined association as resulting from the unified constitution of every simultaneous excitation-complex and of the engram-complex which survives.

From this close cohesion of the whole and through it there results as a necessary consequence the similar cohesion of the components of the whole—components of which sometimes many, sometimes few, occasionally only two, pierce upwards to our superliminal consciousness.

The cohesion, the association of two such emergent components, is manifest when their corresponding engrams issue always together from the latent state, always emerge together as mnemic excitations (= sensations). Ecphory, the issuing forth, is consequently the means of showing the association already existing of two or more engrams. We can say that we recognize the association of two engrams when the ecphory of one entails the ecphory of the other.

But it must not be understood from this that ecphory and association are identical concepts.

Through ecphory I recognize association. Association causes the ecphory of one engram to call forth the ecphory of the other, just as a stone thrown and hitting one of two dogs leashed together will equally drive away the other. But that does not mean that leashing together and driving away are one and the same thing. It is, however, this fallacious identification which underlies the logical error of the concept "*association by likeness.*" I can show this by a concrete example. Suppose somebody asks us what a certain distinguished person looks like. We reflect how to describe his appearance and, suddenly without our having previously thought of the resemblance, see a likeness in stature, beard, and expression to the Emperor Frederick.

Many would regard this as a typical case of *association by likeness.* But what association is there? In the first place we had never associated the appearance of the Emperor Frederick with that of X; but certain particulars in the appearance of the latter (stature, beard, expression) recurring partially to our mind cause this vision of the Emperor Frederick to arise from his engram. The case

is one of ecphory based on a partial reminiscence; not of association.

It might be objected that the process results in association of the vision of X with the vision of the Emperor. Certainly it does, but only when the process is at an end, and has left traces of its creation of a simultaneous coalition of two components in one excitation-complex; in other words it is a case of ordinary simultaneous association. That is to say: The process (*Vorgang*) is only the *cause* of an association; essentially it is 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.* Moreover, this subsequent association is only remarked when the likeness between the two components is not great or, to put it better, when the unlikeness between is so marked that they can be easily separated.

When this is not the case, when the image of the *ecphorized* is so like that of the *ecphorizing* complex that the two cannot be separated, then there is no consecutive association to be noticed.

A similar consecutive simultaneous association following on an ecphory of likeness may be instanced by the example of the hotel guests mentioned at p. 174, who were in every respect unlike one another and belonged to quite different strata of my engram-store but who, because both had similarly annoyed me, arise again together in my consciousness and are therefore simultaneously associated.

Once we have recognised this simultaneous association as the resultant of "an ecphory caused by a partial recurrence," 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.

There is no such thing as association through likeness; there is only what might be described—but the expression is not desirable—as an ecphory through likeness which, however, only covers the fact of a partial recurrence of

an energetic situation; in other words, of an excitation-complex which has left an engram and consequently falls within our second mnemic heading. For the words "partial recurrence" contain the idea of the particular likeness under discussion.

A special technical term for the idea of "ecphory" (exhaustively developed and defined by me in *Mneme*, 1904) has, as far as I know, not been adopted in German psychology.[1] "Calling forth," "awakening" are the renderings chosen, and occasionally also "association" is used in the sense of ecphory. There is in truth a close connection between ecphory and association. The ecphory of one engram entails the ecphory of another simultaneously associated with the first; and, moreover, as we have seen in a number of cases, simultaneous association is a result of ecphory.

Then would it not be simple to describe ecphory itself as association? Perhaps many would be inclined to answer in the affirmative, considering our meticulous distinction to be an unnecessary refinement, but this theory can be rebutted by the very history of the idea of "association through likeness." Let anyone take the trouble to follow the controversy between such distinguished psychologists as Höffding and Lehmann[2] and he will see the confusion arising on both sides from mixing up ecphory and association. Even in Wundt's admirable essay "Bemerkungen zur Assoziationslehre," the treacherousness of association through likeness is not clearly perceived and consequently the imaginary problems resting on that distinction are not adequately dealt with.[3]

[1] The French make use by preference, though not exclusively, of the expression *evocation*, although they often use this word as synonymous with "association."

[2] See especially in connection with this H. Höffding, "Über Wiedererkennen, Assoziation u. psychische Aktivität, II Teil *Vierteljahrschrift für Wissensch," Psychologie*, Bd. 14, 1890; and A. Lehmann, "Über Wiedererkennen," Wundt's *Phil. Studien*, 5 Bd., 1889.

[3] W. Wundt, "Bemerkungen zur Assoziationslehre," Wundt's *Phil. Studien*, 7 Bd., 1892.

The complete vanishing of such problems as a result of a clearer conception and expression of "ecphory *versus* association" is, in my opinion, a sufficient proof of the need for such a differentiation.

In conclusion I should like to make some remarks on the so-called "association through contrast." This is meant when, for instance, the thought of a giant suggests a dwarf; of day, night; of heat, cold.

Here again, association is mixed up with ecphory. It would be more correct to speak of a "contrast-ecphory," if in any case it is desired to give a special title to this kind of ecphory, which after all is such in virtue of ordinary simultaneous association. For ecphory under these circumstances follows not as a contradiction of our second principle, that is not as resulting from unlikeness or contrast, but simply as the effect of that principle of "partial recurrence"; and this paradoxical result is explicable through the presence already established of associated engrams in the engram-store. If there is a particularly close connection between giant and dwarf in my engram-store, it is natural that the ecphory of the word or image "giant" should often immediately entail the ecphory "dwarf." Everybody's engram-store is absolutely studded with such simultaneously associated and contrasted pairs of engrams. Contrasts act in the shape of lively original sensations, and quickly entail pleasurable or disagreeable emotions. They belong consequently to our most powerful impressions, and from earliest youth onwards are engendered in every individual's engram-store as particularly strong and closely interwoven engrams which unceasing repetition fortifies and develops. And the process is favoured by the manner in which every educated person applies and, during self-evolution, utilizes language—that important apparatus for the collection and condensation of associated ideas. Most mothers and nurses already systematize a little when adding to the vocabulary of a child, and teaching him the opposite of some special term which he has caught up, thus making "pairs" of things, as: small, big; hot, cold; fast, slow;

etc, etc. In schools, even in government schools, the practice is furthered, as orthography and grammar are constantly taught in the form of contrasts, as: dwarf, giant; white, black; to cry, to laugh; thus experience and speech create numberless engrams of coupled contrasts, engrams of which the evocation of one of a pair will promptly cause the re-emergence (ecphory) of the other. All these pairings are genetically always simultaneous (= successive) associations, so that what is called "association through contrast," is really only an ecphory based on simultaneous associated engrams.

This examination has demonstrated that a union of engrams can take place only in one way, that is through the existence together in one simultaneous complex of all the original and mnemic excitations which have created these engrams; or, to put it perhaps better, through the previously existing connection of all excitations, original and mnemic, inside one simultaneous complex. The consequent simultaneous association of separate engram-components has shown itself to be the only sort which exists, since close scrutiny has proved that successive association itself must be brought back by a simultaneous connection. Association through likeness and contrast, being a product of erroneous conceptions, has no claim to recognition.

And just as there is only one fundamental form of association—viz. simultaneous association, of which the only sub-category is successive association—so there is but one fundamental form of ecphory, that which, through the partial recurrence of an active situation or excitation-complex registered in consciousness, follows on this recurrence in the shape of original or mnemic excitations.

No other form of ecphory exists, whether in the region of specialised memory or in the universal sphere of "Mneme." It is true that ecphory can assume various shapes, so that it is expedient to group these forms separately and under various rubrics.

In different parts of my work *Mneme*,[1] I drew attention

[1] 2 Aufl., SS. 60, 66, 68, 99, 194, 272.

to a particular sub-group which I called *chronogenous ecphory*. I selected an example as follows (p. 60): "I am accustomed to breakfast at 8 a.m., to lunch at 1 p.m., and to dine at 8 p.m. The complicated stimuli which are bound up with every taking of nourishment, and into which we need not now enter, are accompanied, among other reactions, by special sensations at the sight and taste of food, which we call hunger or appetite, but which no well-nourished person feels in the intervals between meals. Let it be assumed that for some reason or another I begin to supplement my three meals with two smaller ones at 11 and 5 o'clock respectively.

"At first this would not be easy for me, but I force myself to do it perhaps by order of a doctor, and continue it for six months. If at the end of that period I give up the supplementary meals, I become aware of acute hunger. Apparently, then, time or the expiration of a particular portion of time, has an ecphoric effect on the reactions of my sensation-area."

I proceeded further to show that the time-factor or the expiration of a definite interval of time, means for a plant or an animal the cessation of a particular number of vital processes. "The chronometer of the organism is therefore the tempo of its vital processes. But how does the organism, without conscious computation, read off from the chronometer the expiration of an interval of time, or (to put it less metaphorically) why does a special reaction take place after the cessation of a particular sequence of vital processes? Simply because when a particular sequence of metabolic or other vital processes has ceased, a state of the organism ensues which, totally or partially, corresponds to the condition prevailing when a particular engram was engendered, and which, by recurring, causes that engram to be ecphorized."

To revert to the foregoing illustration: The simultaneous excitation- (= sensation-) complex peculiar to the meal at 11 a.m., belongs not merely to the complex aroused by the sight and taste of food, and to other

incidental sensations as well, but to the entire series of metabolic reactions in our sensitive substance, determined by the course in twenty-four hours of all our cyclic functions (sleep and waking, secretion, etc.). Our condition at 11 a.m. is regulated by a whole series of peculiarities which differ from the states of our organism at 8 a.m., 1 p.m., and 8 p.m. And corresponding to this special metabolic condition is a distinct state of excitation in our sensitive substance. When the hour 11 a.m. recurs, this state returns also, and even when the sight, smell and taste of food—an important part of the former simultaneous complex—be lacking, the engram of hunger is still reawakened by it. Thus even this example of chronogenous ecphory proves that the partial recurrence of a simultaneous excitation-complex engraphically registered on our organism is the active agent of ecphory.

I would like here to state why, in formulating my second principle, I attribute ecphory in general to the partial recurrence of a simultaneous excitation-complex which has been engraphically registered on our organism. I do this even in cases where the reawakened engram manifests itself in reactions of *sensation*. I might in such cases have said that the partial recurrence of a simultaneous sensation-complex acts ecphorically. But precisely in cases of chronogenous ecphory there is no recurrence in superliminal sensation, only the metabolic condition entails a state of excitation in the sensitive substance; and, setting aside the question, Whether this is generally made manifest by sensation?—which I believe —it certainly does not reach the superliminal consciousness. Under these circumstances it is advisable in a general definition to confine oneself entirely to the energetic side of the stimulated substance's condition—that is to its state of excitation—and to leave out any mention of the sensation-phase of the excitation-phase as a *conditio sine quâ non*.

It follows from this conclusion that Herbart's "freely ascending images" come also into our second principle.

Leaving altogether out of consideration chronogenous and phasogenous ecphory (the latter to be discussed anon), the excitation-complex to be ecphorized very often fails to show itself in clear sensations or ideas. We can observe in ourselves the various transitions from a distinct superliminal manifestation of the ecphorizing excitation through all stages down to weak and ever weaker consciousness. Even certain organic sensations, as, for instance, that of a hardly perceptible tightening of chest which, as such, never penetrates to superliminal consciousness, cause in me the ecphory of definite situations engraved on my organism. A particularly trustworthy and striking example of this is given by Jerusalem.[1] "Apparently quite involuntarily (or unconsciously) we recall a situation forgotten for thirty years. One wonders at what one believes to be a quite independent recurrence after thirty years' oblivion. Only after a while one discovers that the scent (up to that moment not present to superliminal consciousness)[2] of *Pyrola uniflora* has made itself perceived, and one then remembers the circumstances in which that played a part thirty years previously." Many such striking testimonies might be given; and although it can be alleged on the other hand that we are not always in a position to note so convincingly the unremarked surviving components to whose recurrence the seemingly independent production of mnemic sensations is due, this objection appears to me of little importance, and need not further detain us.

Furthermore, in *Mneme*[3] I described a particular kind of ecphory as "phasogenous." My words were: "Even phasogenous ecphory is in reality only the recurrence of a particular energetic inner situation, and numerous experimental results, as well as statistics of chronological

[1] W. Jerusalem, "Ein Beispiel von Assoziation durch unbewuszte Mitglieder," Wundt's *Philosoph. Studien*, 10 Bd., 1894.

[2] Herein lies the difference between this absolutely authentic case and my experience (repeatedly referred to in *Mneme* and in this work) of the scent of oil perceived at Capri.

[3] 2 Aufl., S. 196.

variations,[1] teach us that a partial recurrence suffices." But since phasogenous ecphory is entirely concerned with hereditary engrams—and in this work we have to deal preferentially with the individually acquired engram-store and its ecphory—we must content ourselves with stating that our definition includes phasogenous ecphory.

In conclusion I offer a brief schematic survey of each phenomena of ecphory as seen to possess certain peculiarities which, however, owing to the form of statement chosen, need only be described as coming entirely under the head of a partial recurrence of excitations effectively engraved in our organisms; that is to say, they belong to our second mnemic principle.

(1) The engram-complex a^1, b^1, c^1, d^1, is ecphorized through the rise of excitation A in the form of a partial recurrence of an engraphic excitation created by one portion of the engram-complex, the component a^1. If, in this ecphory, attention be entirely directed to the component a^1 with disregard of b^1, c^1, d^1, or relative neglect of them, the apparent result is that A alone has called up the engram a^1.

(2) Still taking the example above stated let us assume that attention, or other favouring factors, be specially directed to component b^1 of the ecphorized engram-complex. Then the apparent result is that A has chiefly, if not altogether, called up the component b^1, and we then speak of ecphory in the sense of simultaneous association.

(3) The example is still the same. But the ecphory of the engram-complex a^1, b^1, c^1, d^1, is now (as described at p. 179) enriched by the ecphory of its four immediate successors, composed in their order of a^2, a^3, a^4, a^5, then the apparent result of observing these chiefly is that a^5 has been called up by A on the basis of a successive association of engrams already constituted in the engram-store.

(4) If the engram-store a^1, b^1, c^1, d^1 contains in d^1 an engram which the state of excitation D has generated

[1] I might have added, also a closer investigation of animal instincts.

(such state of excitation being produced by a certain metabolic condition), and if after a certain lapse of time this metabolic condition and with it excitation D return cyclically, the result of this process will be an ecphory of the engram-complex a^1, b^1, c^1, d^1. And this is what I describe as chronogenous ecphory with the difference that the excitation producing ecphory takes place when a particular stage of development is reached, and that the engram it calls up is hereditary and not acquired. Wherefore, we shall not consider this case here, but refer the reader to our description of it in *Mneme.*[1]

The chief conclusions reached in the foregoing chapter can be thus summarized: *Every ecphory depends upon the partial recurrence of the energetic situation or, more particularly expressed, of the simultaneous excitation-complex which has been engraved upon our organism in the form either of original or mnemic excitations* (*second mnemic principle*).

By association we understand the achievement of a complete union of engrams, that is of the mnemic excitations springing up from them. The idea of association is consequently sharply separable from that of ecphory, although they are so far connected that the existence of an association is only revealed by the ecphory of an engram; and, moreover, in a number of cases simultaneous association remains in abeyance as a subsequent manifestation of ecphory. Our chief conclusions as to association can be summarized in the following formal definition, derived from our first mnemic principle:

Association is the union of separate engrams revealing themselves through their respectively isolated ecphories, and it reposes essentially upon the joint presence of its components in one simultaneous complex. It is therefore fundamentally a simultaneous association.

[1] 2 Aufl., SS. 69, 103, 196.

ELEVENTH CHAPTER

ECPHORIC QUANTIVALENCE OF COMPONENTS. UNREVERSIBILITY OF MNEMIC PROCESSES OF EXTINCTION

IN the chapter in *Mneme* on the mutual relations of engrams, I explained at some length one of the principal difficulties which confront us in the ecphoric valuation of engrams produced, on one side simultaneously, on the other successively. I said at page 135: "Although, as we saw, successive association derives from simultaneous association the final result in both cases is and remains very different.

"A chief difference is that engrams simultaneously produced are in a double sense equivalently connected while engrams successively produced are non-equivalently opposed. We conclude this from the fact that when engram *a* is simultaneously associated with engram *b* under usual conditions the ecphory from *a* reacts on *b* as strongly but not more strongly than does *b* on *a*. But when these are successively associated the ecphoric reaction of *a* on *b* is without exception stronger than in the reverse case."

These remarks I would now modify as far as they relate to the mutual ecphoric reactions of engrams simultaneously produced.

The polar non-equivalence of engrams successively produced [1] in respect of their mutual ecphory rests really,

[1] I call two engrams simultaneously produced when the synchronous phases of the generating excitations are simultaneous. I call them successively produced when their synchronous phases follow one on the other, and simultaneousness consequently exists

as we shall see at the end of this chapter, on certain inhibiting factors depending on the nature of individual engram-stores, and on the homophonous interchange of original and mnemic excitations.

These factors do not enter into the mutual ecphory of engrams simultaneously produced. From this and their other circumstances the remarkable difference follows that the connection between successive engrams is unilaterally polarised; but not so with simultaneous engrams. Consequently, one should not say simply that when engrams *a* and *b* are simultaneous "under ordinary circumstances the ecphory from *a* reacts on *b* as strongly but not more strongly than does *b* on *a*"; for the addition "under ordinary circumstances" seems to me now as an insufficient limitation of the statement.

In a simultaneous excitation- (= sensation-) complex the connection of the different components is essentially unpolarized, a fact which follows indeed from our conception of the fundamental processes controlling so-called association.

We proved in our earlier explanations that two independent and separate excitations in association do not form a distinct engram, but that in reality every simultaneous excitation- (= sensation-) complex constitutes a connected whole which leaves behind it in our organism a corresponding engram-complex. This complex when reawakened (ecphorized) by a coincidence of different circumstances as a rule yields up only fragments of its highest emergent components, and as in reproduction these fragments appear to be directly connected one fails to perceive that they are only parts of a unified greater whole. They are fragments of the higher emerging components, but all these components are not of equal height. Engram *a*, as we daily experience, when rising in the shape of mnemic sensation, will penetrate more distinctly to our superliminal consciousness than does *b*, and *c* will be even dimmer in its turn.

only between the acoluthic phase of one and the synchronous phase of the other.

Only by the exercise of direct attention will the latter be felt as a mnemic sensation.

Nevertheless this (same) engram *c* when an original excitation calls it forth can well serve to ecphorize the whole engram-complex to which it belongs and with it the distinct engram *a* and its dimmer brother *b*.[1]

But when again the return of *a* (and also of *b*) ecphorizes the whole engram-complex, *c* penetrates too indistinctly into superliminal consciousness to be remarked under ordinary circumstances, and the ecphory of *a* (also of *b*) does not entail any ecphory of *c* which superliminal sensation will recognise.

It seems, consequently, to us that the ecphoric effect of *c* on *a* or *b* is much stronger than the same effect of *a* or *b* on *c*; but this appearance is due to the fact that the ecphory of *a* and of *b* has a far better chance of reaching our superliminal consciousness than has the ecphory of *c*.

It is also owing to differences in the chance of sensations penetrating to superliminal consciousness that the ecphoric valuation of two simultaneously generated engrams often appears to differ. We might formulate this statement as follows:

"When of two simultaneously generated engrams *a* and *c*, *cæteris paribus*, one (*a*) causes a strong mnemic sensation while the other (*c*) only penetrates feebly or hardly at all to superliminal consciousness, we are apt to assume that the ecphory of *c* acts much more strongly on *a* than *a* on *c*." As an example let us take the oft-invoked simultaneously generated engrams, *a* a vision of Capri and *c* the smell of oil.

I am one of the persons whose sense of smell is normal and on whom, consequently, the deepest engram of smell (an engram thoroughly tested by recognition of recurrence and difference), when called up again through association,

[1] At page 196 (No. 4) we saw that components of a simultaneous excitation-complex which has left an engram can, when returning, reawaken (ecphorize) the whole complex, although they had never penetrated to superliminal consciousness.

scarcely ever produces lively mnemic olfactory sensations. The majority of persons are thus unaffected.[1] It follows therefore that no merely associative ecphory of that engram-complex, whether the recurring component be Capri or some other, will bring with it a clear mnemic sensation of the oil-scent, while the recurrence of that scent suffices to re-invoke a very distinct mnemic vision of Capri. It is consequently quite impossible that the recurrence of *a* can produce as strong an ecphory of *c* as can a recurrent *c* of *a*.

But the case alters altogether when we come to speak of the polarization or unilateral quantivalence of ecphoric action in successive *association*. We have then only to consider engrams whose chances of penetrating to superliminal consciousness are equal and whose ecphory is governed always by equivalent accompanying factors. It suffices at all times to define the ecphoric quantivalence of simultaneously generated engrams by saying that in this kind of connection there is no exclusive arrangement, no polarization.

But there is quite another assertion to be made with regard to the ecphoric valuation of successively generated engrams. For clearness' sake we revert to our old engram-schema, whose origin is to be sought in the schema of original excitations at pages 184–85.

We have now to examine the two successively generated engrams D and E of the schema with respect to their mutual ecphoric quantivalence. The ecphory of D, as shown above, necessarily includes that of d^{r} (engr), since these two engrams are only to be distinguished by the different intensity[2] of their generating excitations D (syn)

[1] But this peculiarity is not the same for everybody. An eminent chemist, with whom I discussed the subject and who observed himself narrowly in consequence, came to the conclusion that in him the mnemic sensation of certain smells will even equalize the original sensation. This is not only an individual peculiarity, but no doubt the professional habit of a chemist causes the sense and the memory of smells to join in producing an analytical *vade-mecum*, and thence a special gift.

[2] Intensity is to be here understood as including vividness.

and d^1 (ac) and of the mnemic excitations D (mn) and d^1 (mn) upspringing from these.

ENGRAM-COMPLEXES

1	2	3	4	5	6	7
C (engr)	c^1 (engr)	c^2 (engr)	c^3 (engr)			
	D ,,	d^1 ,,	d^2 ,,	d^3 (engr)		
		E ,,	e^1 ,,	e^2 ,,	e^3 (engr)	
			F ,,	f^1 ,,	f^2 ,,	f^3 (engr)

The ecphory D (mn) from D (engr) in the second phase naturally acts in the ecphoric sense on d^1 (engr) in the third phase, or, to express it differently, the mnemic excitation D (mn) in the second phase continues in accordance with the fall in intensity as d^1 (mn) of phase No. 3, and in consequence the whole engram-complex of Phase 3, especially including the component E (engr) with its overmastering intensity, is brought to life (ecphorized). Here is a schema of a mnemic process of extinction which entails the ecphory of D (engr):

PHASES

2	3	4	5	6	7	
c^1 (mn)	—c^2 (mn)	—c^3 (mn)	—O			
D ,,	—d^1 ,,	—d^2 ,,	—d^3 (mn)	—O		
	E ,,	—e^1 ,,	—e^2 ,,	—e^3 (mn)	—O	
		F ,,	—f^1 ,,	—f^2 ,,	—f^3 (mn)	O

Exactly the same thing happens when through recurrence of the original excitation E (syn) there results the ecphory E (engr)—e^1 (engr) and with it all the components

of engram-complex No. 4, and especially the component F (engr).

Our schema of excitations gave us at page 185 a derivative engram-schema which forms a very good illustration and elucidation of a fact experimentally demonstrated by Ebbinghaus,[1] namely, that association does not take place only between the members of a sequence following directly upon one another, but, when intermediate links are eliminated, it is found that each member joins up simultaneously with the next following, then with the third and fourth, while all the time losing strength. And in the simultaneous complex 4 of our schema at page 202, we find the engram F simultaneously associated with the relatively strong e^1 (engr), the weaker d^2 (engr) and the absolutely weak c^3 (engr), all of which directly illustrates the phenomena observed by Ebbinghaus.

But neither the above schema nor the explanations we have hitherto furnished enable us to understand why in the ecphory of D (engr) the process goes always over to d^1 (engr), an ecphory of the engram-complex 3, among whose components is d (engr), followed by E (engr)), and why through the ecphory of c^1 simultaneously associated with D and springing up with it (see the schema of mnemic extinctions at page 202) there should not have arisen the ecphory of C (engr). We do not understand why the ecphory should have a predilection for the road D (engr) over d (engr) to E (engr) instead of for the apparently equivalent road E (engr)—c (engr)—C (engr), or, in other words, why (according to Ebbinghaus) the ecphory of one member of an engram-series should not call up its immediate predecessor as distinctly as its immediate successor.

Ebbinghaus expresses himself as follows: "The determinant of this predisposition is a diminishing function

[1] H. Ebbinghaus, "Über das Gedächtniss," Leipzig, 1885, *Grundzüge der Psychologie*, 2 Aufl., Leipzig, 1905, Bd. I, p. 644 ff. Later investigations, especially those undertaken by Müller and Schumann and Müller and Pilzecker, have confirmed Ebbinghaus's conclusions in all points.

of distance between the members of an original sequence. When the distances are equal the connections backward are much weaker than those forward. When the repetition of a sequence is equally frequent on an average, the immediate predecessor of each member is not more closely associated with it than is the next successor but one, and (as far as our few researches enable us to judge) the same proportion obtains between the second predecessor and the third successor."

These peculiarities are, as already remarked, insufficiently elucidated by the explanation of connections which we have given hitherto, and while proceeding on our way we must penetrate much deeper into the nature of the individual engram-store and analyse more closely the interplay of original and mnemic sensations before coming to a clear understanding of the subject.

It is a well-known psychological fact that (to speak for the moment only of original sensations) the dying down of every such sensation is inextricably connected with a sensation of time, or, to put it better, that the dying down as such takes the form of a sensation of time which is inextricably blended into one whole with the special quality of the original sensation.

When we assert that a sensation arises in our consciousness, endures, diminishes and finally ceases, we have incorporated the notion of duration or, what amounts to the same, of time in our description. Everything over and above what we call temporal sensation (perception or representation of time) is derivable from the one fact of consciousness of the duration of sensation and other elementary circumstances of sensation into which we need not enter further. The notion of duration (the lengthy duration of our general consciousness, the shorter duration of one sensation arising and then ceasing) is an elementary fact of our sensory life. Therefore in my view it would be unnecessary to seek for temporal sensation as such in other psychic experiences, since the concept of time is primarily constituted by them and is not involved in any kind of previous assumption. Now

it is clear that a sensation of time, in spite of the objective duration of general organic sensations, could not arise if the temporary content of consciousness were so divorced from its successor as to seem to come altogether to an end. But this, as we know, is never the case, for every conscious content of the moment contains among other elements a more or less accurate knowledge of its immediate predecessors, and this is really the foundation of what we describe as the uprise, duration and cessation of a sensation, things which are all of them the primary facts of consciousness—the peculiar attributes of sensation. What lies before us, then, is the subjective duration of sensations. Objective duration which, yet, cannot be felt as such is mere play of thought.

When I feel a longer or shorter sensation, when my consciousness registers it as a sensation arising, lasting and ceasing, I naturally perceive if the rise, duration and cessation of a second sensation corresponds with the same phases of the first or not ; I feel, that is to say, the contemporaneousness and successiveness of different sensations.

As a secondary consequence of the above a definite arrangement of our sensations arises in harmony with their simultaneousness or successiveness. There is a temporal disposition of sensation in our consciousness which appears, however, as polarized not as reversible, for the reason that momentarily present sensations, the actual simultaneous-complex, the *Now* serves as a mark of orientation,[1] and makes a term. This is how consciousness recognizes an "earlier" or "later" As we have already seen, this successive arrangement of a consciousness-content corresponds to a similar arrangement of our individual engram-store which, when mnemic sensations are ecphorized, polarizes itself into "sooner" or "later" through the determining action of an actual simultaneous complex of original sensations. We might even describe an actual simultaneous excitation-complex

[1] This "mark of orientation" will be studied in the following chapter.

as the stratum whose growth is going on in an engram-store.

In sleep, in hypnoses, in all kinds of pathological strata the sense of time can be so shifted about that, losing sight of intermediate stretches, we join on an actual simultaneous complex of original sensations—a "Now"—no longer to the engram-complex left by its immediate predecessors but to some far-distant one.

Nevertheless, the polarization of the engram-store, so far as it is ecphorized, still prevails in the main within the ecphorized track. We may imagine—long gone by though those days are—that we have to go to school for a year and then present ourselves for a final examination; but never do we think that we have first to pass the examination and then begin school. Imperfect orientation under these peculiar circumstances can lead to great confusion in the use of our engram-store; we can mix up the times in which fragments of it occurred, for even in normal orientation that is possible where portions of the store have grown dim—but all the same these separate bits are polarized into a "sooner" and a "later."

Do these explanations suffice to make clear the fact that mnemic processes of extinction in general or (to keep in view our special conception of the problem) that the processes of extinction in mnemic sensation follow a non-reversible course? Let us take a concrete case, viz., that twenty years ago I heard a tune which then made a great impression on me, but which since that time I have neither heard nor remembered. If somebody now plays it to me in its proper order I recognize it at once; but if played in reversed order it strikes me as entirely foreign. Must I assume that my present simultaneous complex of original sensations acts as an orientation mark and, over the enormous series of intermediate contents of consciousness, fixes an orientation of "earlier" and "later" in that brief sensation-track? It is evident that this explanation is inadequate and there must be some further peculiar explanation; but not essentially a new one; only a consequence of facts already

stated; a necessary product of the mutual relations between processes of extinction in sensation (= excitation) and similar processes throughout our organisms.

We have to start from the fact that the successiveness of the contents of consciousness is felt as such. A content of consciousness includes for us a sum of synchronous and acoluthic sensations (which we describe together as *original* sensations) and of mnemic sensations, besides the occasional emotional quality of these kinds of sensation alike. If for the sake of simplicity we consider only original sensations, we find that every simultaneous complex contains not only other original sensations, but also a number of so-called organic sensations. Organic sensation is a name summing-up various sorts of sense-reactions (such as sensations of pressure, kinæsthetic sensations and special qualities such as hunger, thirst, and so on)—of sensations which are due to the functional activities of our different inner organs. Our consciousness mostly refers these directly to their relative organs (or, if indirectly, then through acquired association), but sometimes they are not localized in any one organ but are distributed throughout the entire body.

The possibility of localizing these sensations, of referring them to one particular organ, differs much according to the nature of the sensations and their intensity.

Some of these sensations have a rhythmical course consonant with the rhythmic organic function which has set them in motion.

Such are the sensations belonging to breathing and circulation in man, and lung-breathing vertebrates in general. These rhythmic sensations are always present in the appropriate organisms, and owing to their action every day and every second they mostly pass unobserved by us, as happens with all permanent or regularly recurrent phenomena. One need, however, only to think, to become immediately aware of them.

Our breathing we notice with ease, but we only observe the normal quiet beating of our heart when our attention is directed on it to the exclusion of everything else.

All these sensations run a course which, in accordance with the special process determining them, is cyclical but not reversible without a total change of character. In spite of being cyclic they are unilaterally polarized, especially so the kinæsthetic sensations and the sensations of pressure which enter into these others. It is, indeed, possible to breathe out or in at will, that is, at a given moment one can begin to breathe in one way and end in another; but in itself neither process is reversible; out-breathing is neither mechanically nor sensationally an inversion of in-breathing. Out-breathing and in-breathing are indeed functionally in opposition but not mechanically reversible. That is to say the rise and fall of the thorax is not determined by the same force acting first in one way and then in another, but while inspiration follows on the contraction of certain muscles expiration is not caused by the contrary action or stretching of these same muscles, but depends simply on their collapse under the weight of the thorax and the elasticity of the lungs in regular breathing. When the breathing is difficult then quite other muscles are contracted. The organic sensations connected with these processes and which are definitely cyclic necessarily correspond in their action.

The same results follow on analysis of the mechanism of circulation and the organic sensations therewith connected; as well as on every biological and chemical process. Metabolic processes are for the most part cyclical, unilateral, never reversible, and in so far as they are bound up with excitations (= sensations) in their widest sense they have a corresponding action on the course of excitation and sensation.

We pass over sensations dependent on other cyclic processes, inasmuch as they scarcely ever penetrate with adequate distinctiveness to superliminal consciousness; and therefore although intrinsically most important for the question we are here discussing they can, as regards our present study, better be relegated to the background.

On the other hand we must lay stress on the

fact that sensations of breathing and circulation with their special rhythm are, so to speak, the accompanying parts of the symphony made by the rise and fall of all our remaining sensations. Or—to change the metaphor—they form the ever-renewed pattern of the ground on which these remaining sensations are embroidered. It is superfluous to add that not only are the traces of these non-cyclical and more marked sensations engraphically retained but there are also existent stereotypes, however feeble, of that pattern of breathing and circulation-excitations which are inextricably connected from phase to phase through simultaneous association with the former. Consequently, when there ensues the ecphory of an engram or sequence of engrams of non-cyclic sensations, not one engram alone but (as already explained) a whole simultanous engram-complex is ecphorized, if faintly, and without the certainty of its penetrating to the superliminal consciousness and being there clearly experienced as sensation. It follows therefore that there is a co-ecphory of breathing and circulation-excitations, which figure as the accompaniment of every other excitation in its course, without being necessarily manifested in sensation. These *mnemic* breathing and circulation-excitations (= sensations) are prevented from reversing their course by the inevitable presence during every ecphory of *original* sensations of breathing and circulation which run alongside, or nearly alongside (that is homophonously), with the others. I shall not dwell here on this aspect of homophony but refer the reader to my full explanations on the point in *Mneme*, especially its fourteenth chapter, as also to the next chapter of the present work.

These reasons show plainly the impossibility of a reversed course in mnemic succession, and the same reasons elucidate the observations made by Ebbinghaus as to the ratio of force in the ecphoric action of a mnemic sensation, backward and forward, in an engram-sequence. Turning again to our schema at page 202, the ecphory of the engram E (engr) leads to the mnemic sensation *e* (mn).

And along the track of simultaneous association this produces an ecphory of D (engr) as well as of F (engr).

But as the course on the whole starts from the simultaneous complex of Phase 2 in the direction of the simultaneous complex of Phase 4, the ecphory of the engram D (engr), although equally inclined in itself to E (engr) and F (engr) is inhibited, and this inhibition of the ecphory of D (engr) compared with that of F (engr) is expressed in Ebbinghaus's "ratio of forces."

When therefore I repeat, reversing the direction, the original stimuli which have produced an engram-sequence, I am setting up, besides new original sensations, a number of ecphories of associated engrams, and thereby produce (occasionally under such circumstances unaccompanied by noticeable ecphory) a mosaic of single mnemic sensations in reversed order. But these are not directly connected with one another, only, link by link, with the new original sensations. They do not therefore constitute any connected mnemic process running an independent course alongside the contemporaneous original one. But, as I shall show farther on, recognition and difference depend on the homophony of original and mnemic processes; and nothing approaching recognition can take place when a melody is played backwards; or the meaning of a phrase phonographically reproduced is reversed, or a series of complicated movements are shown inverted on the film.

The explanations given previously were chiefly concerned with the large number of cases in which sequences of original excitations manifested by sensation are deeply engraved in the organism and appear through ecphory as a succession of *mnemic sensations*. We have now learnt the reason why a successive process in mnemic reproduction cannot take a reverse direction. In *Mneme* I was at pains to show that the mnemic reproduction showing itself as movement, secretion, or growth, is subject to exactly the same laws as govern that which is manifested by sensation. Whether I have proved

my point or not I will not here discuss; but what the present concrete case proves is that the causes which prevent a reversed course in sequences of mnemic sensation act with equal efficacy where the reproduction of movements, metabolic processes and growth-impulses are concerned. What is common to all these cases is the process of excitation in organic substance set up as in original excitation by some stimulus, then engraved on the organism and ecphorized in the form of a mnemic excitation.

The particular form in which original and mnemic excitations may exhibit themselves, whether through sensation, movement or growth is of secondary importance.

Alongside also of the mnemic reproduction of the results of excitation not manifested in sensation, there runs a mnemic reproduction integrally associated with the said excitations of the cyclic and unreversible processes of breathing, circulation and metabolism—all of which are imprinted on the aforementioned background. And it is the homophony of these cyclical mnemic processes with the corresponding ever-present cyclic original excitations which, in every case, forbid the reversal of mnemic processes, whether the manifestation involved presents itself as sensation or any other phenomenon.

In our ground pattern we have now learnt to know an essential and thoroughly typical component of the individual engram-store, and now that this result has been obtained it seems advisable to review the principal classes of engrammic elements which go to make up the said store. For thoroughly considered reasons we described an engram-store as a continuously stratified series of engram-complexes. To whichever is the last simultaneous engram-complex there becomes attached the present simultaneous excitation- (= sensation-) complex as the layer where growth takes place in the engram-store.

Every simultaneous excitation-complex consists in:

1. Original excitations.
2. Mnemic excitations.

The original excitations are either in a synchronous or acoluthic phase. Mnemic excitations (of which the phases shall be reviewed in the next chapter) arise from various strata of the existing engram-store which ecphorize them directly in part from simultaneous original excitations, in part from successive mnemic excitations.

To original excitations belong also those being manifested as "organic sensations" which are usually relegated to the background of consciousness, but nevertheless claim recognition because of their cyclic character and because they imprint a kind of ground-pattern upon the strata of engram-complexes.

When a previous simultaneous excitation-complex yields its place to a successor, it leaves an engram-complex behind it, whose components in the order of their origin are divisible as follows:

1. Original excitation-engrams,
   (*a*) in their synchronous phase,
   (*b*) in their acoluthic phase.

2. Mnemic excitation-engrams,
   (*a*) those which are simultaneously "ecphorized" by original excitations,
   (*b*) those which are successively "ecphorized" by mnemic excitations.

3. The stratified series of an engram-store finally shows a ground-pattern left by the cyclically recurrent organic sensations and making a sort of background on which all the other engrams are embroidered.

TWELFTH CHAPTER

MNEMIC SENSATION AND HOW IT DIFFERS FROM ORIGINAL SENSATION

OUR introductory remarks here bring us back to a course of thought which we followed out in detail in *Mneme.*

The ecphory of an engram produces a condition of the stimulated substance which I describe as mnemic excitation. But this condition cannot be apprehended directly; its existence is deduced by us from its manifestations.

These can be divided into two chief groups: firstly into reactions in consciousness, that is, sensations in the widest sense with or without affective accentuation (pleasure = pain quality); secondly, reactions in the shape of motor, plastic and metabolic processes which one can be aware of in oneself and in others, and which are consequently called objective, in contradiction to the reactions in consciousness or sensations which are only subjectively apprehended.

As in the present continuation of *Mneme* we are principally concerned with sensations in the widest sense, we shall now study only such mnemic excitations as are manifested through reactions in consciousness.

These reactions we call mnemic sensations in the widest sense; and we describe as mnemic feelings the affective accentuations accompanying such sensations. We give the name of mnemic sensation only to one which betrays a mnemic excitation, that is to say, an excitation caused not by an original stimulus but derived from the ecphory of an engram.

How can we tell that an excitation (= sensation)

does not arise in the ordinary way but is derived from ecphory ?

This point has been fully explained in the sixth chapter of *Mneme* and in the tenth of the present work. The differentiating feature is that the mnemic process of excitation, whether objectively manifested as in motor, plastic or secretive reactions, or subjectively through sensation, requires for its emergence only a fragment of the conditions which are necessary to call forth the same excitation in its original form. This differentiating feature, based on our second mnemic principle, consists in the manner of the emergence of the two excitations and not in the nature of the excitations themselves.

We have now to ask ourselves, Whether between these two groups of excitation, or (as we are here only studying those excitations which are manifested in reactions of consciousness) between these two groups of sensation, there are any differences (over and above the diversity in origin) which can be recognized by their mode of proceedings in consciousness, and are the differences such as to be distinguishable through some essential quality ?

The answer to this question, which usually can be apodeictically decided now in one sense and now in another, seems of sufficient importance to be thoroughly examined. In my opinion a correct judgment demands investigation on every side.

Let us begin empirically by supposing ourselves to be in a concert hall. The performer is at the piano ; the public, motionless, is waiting for him to commence. I shut my eyes in order to remain undisturbed by the sight at once of preliminaries and of my neighbours, and I am expecting every moment the subdued sound of the adagio in Beethoven's C Minor Sonato. The well-known sequence of notes rings clearly in my ears ; I hear the quavers and semiquavers of the bass-octave, the striding triplets of the treble, and yet I know with absolute certainty that the performer has not yet begun, that what I hear is mnemic only. Then the pianist starts, and I know with equal certainty that the soft tones I

now hear are the cause of original sensations in me. What we usually do not know, or at least we are not clearly aware of, is to what extent these original sensations are linked up and permeated with mnemic ones. This is a point to which I shall return later. Anyway, we have here a case in which to my consciousness original sensations are unmistakably distinguishable from the corresponding mnemic ones. The case is purposely selected to exclude almost entirely any difference based on an accompanying factor. Both sensations are undoubtedly felt as separate; and why so felt is a question which we must go into after examining a contrary example.

This example I derive from the same region of sense: together with some guests, we are awaiting in a quiet rural spot the arrival of a carriage which is to bring friends whom we have not seen for a long time. We listen intently so as to catch the first sound of wheels. Somebody calls out "Now"; all listen anxiously, and others, thinking they have heard the sound, say "Yes, it is." But the noise, instead of approaching, ceases, for it was only the mnemic evocation of a far-off roll of wheels. Anon somebody else says "Now," and we ourselves think we hear something, but having grown sceptical we decide for a mnemic sensation merely. On this occasion we have erred on the contrary side, for while still doubting we become aware of such a distinct sound that we can no longer mistake its character as an original sensation.

Here, then, we obtain a result the opposite of the previous one.

At first we have not be able to decide whether we were dealing with a mnemic or an original sensation; we came only doubtfully to a conclusion, and as often as not we find that the conclusion is erroneous.

We have a similar experience when expecting some familiar but not easily perceptible optical phenomenon, as might be the first shimmer of dawn, especially if we are anxiously awaiting it. For this state of anxiety, concentrating attention on one spot, conditions, when

ecphory eventually takes place, a very much greater vividness in the corresponding mnemic sensations than is the case under ordinary circumstances.

But there is yet a third case in which, at least in my own subjective experience, the impossibility at times of distinguishing in consciousness the difference between real and mnemic sensations is peculiarly marked.

I am an extreme victim to the salivary secretion of blood-sucking insects, and neither my experience on board my lugger *Hekla* nor of mosquito nights on the Niger or at Cape York [1] have hardened me to the slightest degree, so that the mere suspicion, while undressing during travel, that the bedroom may be infested with parasites is sufficient to make me feel bitten at once. On endless occasions I have had to satisfy myself by ocular examination that I was mistaken, but it has also sometimes happened to me after persuading myself that imagination had played me false to discover on investigation that I had mistaken a true sensation for an imaginary one. This sort of thing happens to many sensitive persons, while others cannot even understand such "fancies."

I have instanced this case, for the very personal character of which I ask the reader's indulgence, because close and repeated observation has convinced me of the simple impossibility in such cases of discovering through mere study of the processes of consciousness whether the sensation I had was original or mnemic. The examples and counter-examples above given, together with numberless parallel experiences lead to the confident conclusion that in our waking state we have no difficulty in distinguishing between an ordinary original sensation and an ordinary mnemic one; while this is not so as regards the difference between some barely perceptible original sensation and a mnemic one which for some reason happens to be notably accentuated.

Between the two above-described groups of apparently

[1] R. Semon, *Im Australischen Busch*, 2 Aufl., 1903, S. 341 and S. 350, etc.

opposed cases, we have numberless transitional instances. It happens to many of us even in our normal waking state, under conditions of particular concentration and intensity of mind, to experience a mnemic sensation with such vividness that it equals or nearly equals an original one. Johannes Müller,[1] who made many experiments in this direction, wrote: "On one occasion, after I had endeavoured a whole evening unremittingly to evoke with closed eyes a red colour in my field of vision, and in order to strengthen my plastic imaginations had laboured to recall the liveliest images of red-coloured objects, such as curtains, cloaks, coloured windows, red fire and so on, I just once had a passing vision of a fold of red cloth—an object of which I had not tried to recall the particular outlines. This specific product of my visual fancy appeared and disappeared as by magic."

Altogether isolated are remarkable cases in which vivid phantoms are summoned into the field of vision by a slight voluntary effort of imagination.[2] The earliest example is given us by that strange personage, Cardanus, before whose eyes involuntary images so often floated, and who relates that he could vividly see whatever he wished.[3] "Again, there is the case reported by Gruithausen [4] of a man who in youth could see in his mind's eye with utmost vividness and relate to his father things which later appeared to him much less distinctly. The artist, H.,[5] could often see voluntarily and distinctly and in colour imaginations which had occurred to him in the dark. But these voluntarily evoked phantasms transform themselves independently of the will." Johannes Müller goes on to allude to the facility possessed

[1] Johannes Müller, *Über die phantastischen Gesichtserscheinungen*, Coblenz, J. Hölscher, 1826, p. 82.

[2] By "vivid" (*leuchtend*) here and in the following remarks we must understand the meaning to be, "with the distinctness of an original sensation."

[3] See Cardanus, *de varietate rer*, lib. VIII, p. 160 ff.; *de subtilitate*, XVIII, p. 519 ff.

[4] *Anthrop*, § 449.

[5] *Ibid.*, § 117.

by Goethe in *his younger years* of seeing with the clearness of original impressions imaginary flowers and ornaments which he called up before his closed eyes. Goethe's experiences differ from the above-named through the fact that the imagined object, though as vividly seen as an original one, never retained its form an instant, but "immediately changed from the middle towards the periphery exactly as in the now newly discovered kaleidoscope."

Characteristic in Goethe's case, as in the man mentioned by Gruithausen, is the assertion that the facility of evoking mnemic sensations with the vividness of original ones declines with advancing years.[1] Similar statements are common.

I have no doubt that a careful collection of such cases would not only increase their number, but would testify to their occurrence in other fields of sense; as, for instance, in hearing, where in waking hours mnemic sensations can equal original ones in distinctness. But for our essential purpose the examples given under the head of sight suffice when joined to the personal testimony of Cardanus, Goethe and Johannes Müller.

The net result of the instances given is that in a normal waking state it is very difficult but, as the case of J. Müller shows, not at all impossible through close attention and the elimination of disturbing conditions to produce a mnemic sensation equalling the original one in vividness; and, as we have seen, there are persons especially gifted that way whom we should yet not be justified in describing as abnormal.

Under normal waking conditions then, the gulf between the vividness of clearly original and that of clearly mnemic sensations is not unspannable, setting altogether aside the fact that there is no gulf whatever between the mnemic

[1] Goethe, *Zur Morphologie und Naturwissenschaft.* Also in *Wahlverwandtschaften* Goethe in various places mentions the connection between mnemic and original sensations, with special reference to their lifelikeness. See the cases cited by Johann Müller, *ibid.*, pp. 22 and 44.

and original sensations when both are on the threshold of consciousness.

As soon, however, as we are no longer quite awake, the increase in vividness of mnemic sensations until they reach the level of original feelings is a very common phenomenon. All that is required is for the waking condition to be not entirely suppressed, but diminished only; and above all, strong original stimuli must be eliminated as much as possible. Under such conditions, by closing their eyes many persons can produce optical phenomena, images of many different objects, people, animals, plants, illuminated spaces which have all the characteristics of reality. For detailed description I refer the reader to the works, already mentioned, of Johannes Müller, who has exhaustively investigated all these phenomena.

Important is his testimony that not only in the night, but at any hour of the day, he could call up these apparitions, to which, in many hours of quite sleepless repose with closed eyes, he devoted his observation. He adds that in a "wideawake condition and free from all superstition and all superexcitation" he had the same experiences.

In one place, however, he does describe his condition as that of being "half awake," and that seems to me to accord with his assertion[1] that the images vanish as quickly as they came when play is given to reflection. I myself belong to the class of persons who are far less frequently and pleasantly subject to these illusions than were Goethe, Müller and probably many others. Having, however, somewhat cultivated this habit, I am aware of them fairly often when I close my eyes and, as Johannes Müller says, "abstract myself from all else"; but in my case they are brief, and rouse me, so to speak, from my repose when they become vivid.

They are sometimes things *seen*, but more often are just my own thoughts spoken loudly at my ear. It is this precisely which startles me and puts an end to the illusion which has found me in a half-awake condition

[1] *Ibid.*, p. 30.

lasting only a few seconds. According to Müller's account, the phenomena in his case were more easily produced, lasted longer and occurred in a condition of much fuller wakefulness. His sensations were altogether visual; mine are sometimes auditory, sometimes visual.

Very interesting is Müller's assertion that by fasting he could lend an extraordinary vividness to the illusions.

As regards authentic dreams, to which we now turn, it can be said as a rule that the mnemic sensations which form the woof of dream-life are experienced with all the vividness of real feelings, so that they can be and are mistaken for the latter.

In this seems to me to consist the principal difference between mnemic sensations in dreams and those which we have when half awake, at any rate as regards "phantasms" of the kind described by J. Müller. In spite of their vividness, their "brilliancy," he always knew for a certainty that they were not called up by any original stimulus, particularly as he was always aware that his eyes were shut and he had consequently maintained the due orientation between the actual simultaneous complex and the upper stratum of his engram-store. He describes in a wonderful manner[1] the difference of his attitude towards the mnemic sensations which in a half-awake condition and in dreams assumed for him the liveliness of original sensations. "Dream pictures are nothing but luminous ghosts of objects which before sleep have impressed themselves on the optical substance as one closes one's eyes. As a rule, their objectiveness is apprehended; often one is conscious that they are only dream-pictures; and in the latter case they are not to be distinguished from the fantastic images which one has perceived before sleep. In observing such images before slumber, I have often been surprised by the beginning of a dream. The true dream, in which reasoning and recognition of the objectiveness of the images are in abeyance, arises most easily and immediately when darkness has been succeeded gradually

[1] *Ibid.*, p. 49.

by the inner subjective illumination of the optical field. For a long time one has contemplated bright phantasms in the dark; then gradually the whole field of optics is illuminated inwardly as by day and the phantasms seem to move in this light. And, absorbed in the contemplation of this inner daylight and all that is passing in it, one is easily liable to forget reality, especially as no sensory impression is there to bring it before one."

In these words Müller hints at that which in my view especially characterizes the sense-life of dreams, i.e. the erroneous interpretation of mnemic sensations as real ones. This happens at least with the majority of the mnemic sensations which we have in dreams. The words we dream for the most part are "heard," and often we dream that we are *thinking* something; we are accustomed, as has been strikingly said, to "dramatize" our dreams. Mnemic images of the living and the dead come before us with the liveliness of original sensations, are almost without exception accepted by us as such, and appear to be not subjective reproductions but objective impressions acting on our organs of sight and hearing. When associatively, perhaps as a result of some slight original sensation, such as an uncomfortable couch or too heavy a coverlet, there is ecphorized the mnemic image of some old teacher whose stupid grammatical contentiousness and general pedantry made him the chief object of our boyhood's hatred thirty years ago, we do not merely "remember" this person, dead for fifteen years past, but we *see* him in the flesh.

Thus the whole simultaneous stratum of the engram-complex to which he belongs in our dream, and which has "ecphorized" him as its central figure, gains reality, appearing not as the ecphory of an old stratum, but as that of a present one, that of the present simultaneous complex or original sensations which is "Now." We are ourselves thirty years younger; we are again going to school and having to pass our final examinations. It sometimes happens that later engram-complexes are ecphorized at the same moment. Then in our dream

we urge our objection: "What, again a final school examination! But I have already graduated at the University!" Oftener, however, the mnemic complex springing from an early engram-store gains the upper hand and, seeming to be the top complex of that store, triumphs completely over any objections urged by the co-ecphory of later strata. Frequently no such objections present themselves, and we communicate unsurprised with persons whom we well know to have been dead for years. We can formulate the following rule: We accept the mnemic sensations belonging to a deep-seated engram-store as real original sensations; we make of that store the uppermost stratum and regard it in the light of our engram-store's germinating stratum—in short, as the "Now."

These circumstances also explain the chief features of our sensory life in dreams—not all those features, but the principal ones. The residue is owing clearly to the remaining characteristics of mnemic sensations, the manner in which our engram-store is built up; also to certain physiological peculiarities of the sleeping state.[1] I cannot here discuss this theme exhaustively, and must leave it with the few remarks I have made. I hope at some time not too far off to have the opportunity of examining in a much shorter treatise the process of original and mnemic sensations and feelings during dreams. It appears, therefore, that in the half-waking condition it is not infrequent for mnemic sensations to take on the liveliness of original ones, but despite this, and owing to other peculiarities, especially the survival of the sense of the true position of the most recent complex of the engram-store, these mnemic sensations are recog-

[1] The view that every dream is an embodiment of which the kernel is formed by a secret "wish," and that the underlying fabric of every dream is the mirage that a forbidden wish has been fulfilled, does not seem borne out by the voluminous material which I have collected, nor do I find that the author of this opinion, S. Freud, has advanced, as proofs, any but forced interpretations of facts which could be explained as well and usually better and more naturally in another sense.

nized as being such. In the dreaming state this discrimination is lost, and almost all mnemic sensations and feelings are mistaken for original ones. Already Johannes Müller[1] demonstrated that in the hypnotic condition (known in his time as "magnetic") things happen as in dreams. He showed a really wonderful insight into the nature of hypnotism in a chapter on "Magnetic Illumination" in his work written in 1826; and his views, though lost sight of at the time, were worked out again much later (by others). He also described a number of waking conditions in which the influence of certain emotions so increases the vividness of mnemic sensations as to cause them to seem original ones.

These states are various forms of passionate excitement, and especially religious ecstasy in which, as Müller found from his own experiences when half awake, long sustained fasting entails a rise in the vividness of mnemic processes.

Certain narcotics have a similar effect; and then we get the whole array of hallucinations with every possible pathological accompaniment. To all these phenomena what is common and here particularly interesting is the peculiar condition of consciousness which results in a larger or smaller number of mnemic sensations being regarded as original, with all the consequences following on this misapprehension. We have now collected the principal facts which are necessary for understanding the difference in consciousness between original and mnemic sensations, and are in a position to sum up as follows: In a normal waking condition we distinguish as a rule between original and mnemic sensations owing to the far superior vividness of the former. But there are wide degrees of vividness between the two kinds of sensations themselves. The vividness of mnemic sensations, for instance, depends on one side upon the nature of the ecphorized engrams, that is, the effectiveness of the original engraphy, on the other side upon the age[2] of the

[1] *Ibid.*

[2] The disappearance of engrams is a subject which I prefer to treat at length in my *Pathology of Mneme.*

engram, together with its reinforcement by homophony (a point to be considered in the next chapter), and finally upon circumstances accompanying the ecphory, especially the output of attention. First and foremost the vividness of an original sensation depends upon attention but much less than is usually believed upon the sensation as such; and here again vividness is reinforced by homophony.

Before distinguishing between the vividness and the intensity (in the narrow meaning) of sensation, let us affirm summarily that there are many transitions between the vividness of the most " washed-out " mnemic sensation and that of the liveliest original sensation of a similar kind. On the other hand, if the gulf between the liveliness of an average original, and of an average mnemic, sensation is very marked in our normal waking condition, it cannot in any sense be described as unbridgeable. There is no essential difference between the two sorts of sensation, but only one of degree. This view was probably stated for the first time by Hume,[1] and emphasized by Mach as follows: " *They* (i.e. mnemic representations) *do not represent any new element in respect of our original sensations. Both appear to be of the same nature.*" [2]

This graduated difference in vividness between original and mnemic sensations in our normal waking condition (but only in that) is indeed sufficient for us to distinguish easily, as a rule, between the two kinds of phenomena; and we are consequently able to discern correctly what complex at the moment is uppermost, which growth-stratum of engram-store we have before us, and so to preserve the proper orientation in regard to the engram-store and the portion of it ecphorized at the moment.

[1] *Treatise on Human Nature; Inquiry concerning the Human Understanding.*

[2] E. Mach, *Erkenntniss u. Irrtum*, 1905, p. 20 (see also *Analyse der Empfindungen*, 1903, p. 159). The objection raised by Ziehen (" Erkenntniss theoretische Auseinandersetzungen," 3 *Zeitschrift f. Psychologie*, Bd. 43, p. 243) to Mach's ideas in this respect I consider, on close investigation of the question, to be unfounded.

This is eminently important if we consider the confusion of mind arising when mnemic sensations are conceived of as original, and in consequence the uppermost complex of the moment and the growth-stratum of the engram-store are misapprehended.

I would here deal with an objection which might be advanced against the opinions I have expressed. It might be said: Whether or not there be all degrees of transition between the respective vividness of mnemic and original sensations, there nevertheless exists in consciousness one unmistakable and decisive token of difference. This is the sensation of the share taken in the proceedings by the appropriate sensory organs. If, for instance, we see a sunny street, and on another occasion only recall it to mind, there is this palpable difference between the two cases that in the first we know that we have used our eyes, and in the second we know that we have not. And what is true here is true as regards all our senses.

But this factor of differentiation is worthless for a whole series of phenomena, as has been demonstrated in the first part of this work (pp. 80, 88, 90), where it was shown that under ordinary circumstances we see without feeling that we use our eyes, hear without knowledge of the participation of our ears, and smell equally without knowledge of the share taken by our nose. The case changes when we see, hear or smell with effort and attention, but such effort of attention is of no use for deciding between mnemic and original sensations in doubtful cases.

Very instructive in this connection are the examples given above of our readiness to affirm that an imaginary distant sound of wheels has distinctly struck on our ears; that a fancied glimmer of light affected our eyes, and that non-existent insects were really stinging us in a particular spot of skin.

The illusory participation of peripheral organs of sense is such cases is indicated by an observer like Gruithausen, who stated that dream-pictures move in harmony with

the movements of closed eyes, even after the subject is awake.

It is true that J. Müller's opinion,[1] expressed in the words: "I have never been able while still awake to lend movement to phantasms by moving my closed eyes" disproves Gruithausen's affirmation, but the mere fact that a difference of opinion is possible on such a point shows that when the other factors of orientation of sensation as original or mnemic is lost, there vanishes the power of determining whether the peripheral segments of the visual substance (the real organ of sight) are involved or not in the sensation of seeing.

In conclusion, I must indicate a group of facts which are strongly against the acceptance of the above standard of differentiation. These facts belong to the illusions produced by pictures, especially in the matter of perspective. Hering[2] calls this phenomenon "supplementary reproduction," and adds: "A few dots and combined strokes suffice to give the shape of a human form, and without close attention we are not aware that we are seeing what is not on the paper. And if we go carefully through the drawing we see that, here and there, outlines are missing which at first we really perceived. This *real* seeing of something which has not been impressed on the retina but is only the effect of a reproduction upon our nervous system (or is only an addition made by our nervous system to the reproduction), is essentially identical with the condition described as sense-illusion when pathologically developed. These additions, through supplementary reproduction, to our sensation-complex depend like the remaining effects upon a reaction (more indirect, it is true) of our nervous system on the retinal image, and as long as they exist we justly describe them as sensations, for, while present, they differ not at all from the sensations produced in the retinal image by a real stimulus."

[1] *Ibid.*, p. 37.

[2] E. Hering, "Physiologie des Gesichtsinnes," Hermann's *Handbuch der Physiologie*, III, i, p. 569, 1879.

In all the numberless cases in which this supplementary reproduction comes into play, or, to use our terminology, in which mnemic sensations associate themselves with, and complete, original sensations[1] we remain entirely under the impression that the former, like the latter, find their entry through our organs of sense. Our criterion of difference fails us then entirely even in those numberless cases in which we can directly compare the two kinds of sensation, and we are reduced (on the basis of the only proof we have, limited to one direction though that is) to the conclusion, shared by Hume, Hering, Mach and others, that *our consciousness* furnishes us with no absolute standard of difference between original and mnemic sensations. Such a criterion can only be obtained objectively. It consists in the different modes of production of the sensations.

Finally, we must consider a point on which, up to now, we have only touched in passing, not bestowing on it, therefore, the care it deserves. *Intensity of sensation* in the strict sense, the characteristic original sensations which depend directly on the strength of the producing stimulus, is, as we said above, in no way identical with the vividness of sensation. At page 121 we were led to the recognition of this fact when explaining the homophony of original sensations, and it will figure in a later chapter on mnemic homophony. The proposition holds good equally for the comparison both of original and mnemic sensations with one another, as well as with the reciprocal comparison between the two classes.

As regards original sensations, for instance, one lends an attentive ear to some very slight sound, such as the step of a person cautiously approaching; one hears it with the utmost distinctness and liveliness, but still one hears it as a slight sound, very vivid but not intense. The

[1] See, for instance, page 167, where we adduce the example of a planimetric figure which, owing to the intrusion of compelling mnemic sensations, almost always has the semblance for us of a solid body and can only be apprehended as flat by a particular effort of attention.

pianissimo of a song, of which we catch the faintest tones, in spite of its perfect, never-exaggerated clearness, in spite of the concert-room's breathless stillness and of the general eagerness to hear a celebrated songstress for the first time, remains only a pianissimo. On the other hand, the fortissimo of some noisy open-air band, to which we listen inattentively with only half an ear, offers the contrary example of a very intense but by no means vivid sensation.

The same results follow on examination of our mnemic sensations. I can re-create the magic of that wonderful pianissimo of the songstress so that it sounds incarnate in my ears but is still pianissimo; and I can recall the blare of the open-air band as far off and indistinct but still noisy.

The peculiarity that real intensity and vividness of sensations are parallel often but never identical is evidenced by observation of these two qualities through a comparison of original with mnemic sensations. Simple reflection immediately shows that these two kinds of sensation differ generally in vividness and not in intensity. We have seen, it is true, that original sensations of insignificant intensity are sometimes confounded with corresponding mnemic sensations, and here in point of fact intensity does come into play in determining a separation or, rather, want of separation. But we do not find that an original sensation of uncommonly slight intensity, as, for instance, a barely perceptible rustle, is indistinguishable from a mnemic sensation of great intensity, so that, we will say, an original pianissimo sometimes borders on a mnemic fortissimo. What happens is that the slight intensity of the original resembles the slight intensity of the mnemic sensation.

The barely heard sound of real carriage wheels is recalled as barely heard, the faint, original glimmer of light is equally faint in its mnemic reproduction, and the sensation of a slight touch returns to mind as such, and not as a violent thrust. The possibility of confounding the two sorts airses entirely from the peculiar fact that

as the special *intensity* of an original sensation decays its *vividness* diminishes also, though only to a very small extent. But if, through the weakened intensity of an original sensation, its vividness sinks to the level of its mnemic colleague the obverse is not true, for an increase in the intensity of a mnemic sensation does not lend it the vividness of an original sensation. When I recall to mind the pavement in front of my house in the dazzling glare of midday sun in July, this image is not to the smallest noticeable extent more vivid than the mnemic reproduction of the pavement in the dim lamplight of a rainy winter night, and as a rule it is infinitely less distinct than the original sensation made on me by the sight of the pavement in the dimmest illumination.

If I want to increase the vividness of a mnemic sensation I do not seek to recover its intensity by recalling the night street as brilliantly illuminated, or the voice of a friend at its loudest pitch, or the feeling of a slight touch as a violent push; I leave its intensity alone, and concentrate my attention on the particular mnemic phenomenon by discarding all other mnemic, and especially all other original, sensations. Then the vividness regularly rises and sometimes (but not as a rule for persons in the normal waking condition) it attains, or nearly, to the distinctness of an original sensation. It must be admitted that the increase of vividness follows more easily on high than on low, intensity; nevertheless, the connection between the two is relatively loose, since increased intensity causes only a slight rise in vividness, and if a certain dependence of the latter upon the former is undeniable and might suggest closer investigation, that does not invalidate the assertion that the vividness of a sensation is an element quite separable from the intensity which is conditioned by the degree of stimulation.

I would sum up as follows the results of the survey (not easy to set forth clearly) embodied in this chapter:

1. In our normal waking condition consciousness distinguishes as a rule original from mnemic sensations, in virtue of their differing vividness.

2. Both original and mnemic sensations are variously vivid. An absolute standard for distinguishing between the respective vividness of the two kinds of sensation does not exist; for it happens that under certain circumstances the vividness of original sensations sinks to the level of mnemic sensations, while, on the other hand, that of mnemic rises to the height of original sensations.

3. The vividness of a sensation is not entirely independent of its intensity (in the narrow sense), but constitutes nevertheless a separate element.

THIRTEENTH CHAPTER

HOW THE PROCESSES OF MNEMIC AND ORIGINAL SENSATIONS ARE RELATED: PROPORTIONAL VARIABILITY.

In the preceding chapter we have studied the way in which mnemic and original sensations differ from one another, and our conclusion was that, setting aside the difference in the mode of production, it is impossible to find a universally applicable distinction between these two classes of sensations considered as such, since difference in vividness, although very usually obtaining, cannot be considered as a universal characteristic.

Accepting then the conclusion that between original and mnemic sensations in consciousness there is no difference in essence but only in the mode of their production, we have next to inquire how far the mnemic sensation resembles in detail the original sensation which has laid the former's engraphic foundation.

After our foregoing explanations the answer is easy. A mnemic sensation perfectly resembles its corresponding original sensation in all recognizable particulars; two factors only having to be kept in view, as without them no complete survey of all the facts can be accomplished. First, we have to remember the usually very significant diminution of vividness differentiating mnemic sensations from original ones, the effect of which is that the mnemic complex of sensations is usually a much feebler and less detailed reproduction of the original complex. This point has been dwelt upon at page 161. In the second place it is to be noticed that mnemic sensations regularly accompany all parts of the original complex,

whose image is thereby completed, embellished or blurred, and often notably changed. Moreover, the engram retains these additions and, when next ecphorized, reproduces them. The new mnemic sensation is consequently no true and exclusive image of the original sensation, but rather of an original sensation plus various mnemic accretions.

But of course the two factors of difference constitute no real exceptions to our rule, they merely form a kind of disguise which closer observation is able to penetrate. Therefore, in saying that a mnemic complex of sensations is the true (if much less vivid) reproduction of an original one, we are so far only comparing a mnemic *simultaneous* complex with the related original complex, and we have now to ask ourselves the bearing of this reproduction on the temporal values, on the duration of mnemic, compared with original, sensations.

There is no difficulty in proving empirically that a mnemic sensation in its duration or, to speak more correctly, in its temporal values is a true representation of the original whose engram has ecphorized it. Of this we have, e.g. an indisputable proof in a melody once heard and mnemically recalled, for not only are the several tone-sensations reproduced, such as pitch, timbre and mutual relations of intensity, but likewise the relative duration of the several mnemic tone-sensations is a true image of the original ones. And the same remark applies to a series of optical sensations. The image of a movement, for instance, constitutes just such a series of optical sensations having various durations. Here again, the mnemic image reproduces exactly the time relations between the different phases of the original. The like can also be said of tactile and kinæsthetic sensations, the rhythm of the mnemic sensation-sequences being identical with that of the original. For instance, the printed notes of a musical score can be regarded as the indication of what we are intended to play, the indication of the precise acoustic stimulations we are intended to call forth. But these printed

notes can likewise be regarded as a graphic representation or chart of the original acoustic sensations which had been elicited by those stimulations. Thus we can equally use this printed piece of music in order to verify the correctness of a fresh performance or consider these printed signs as symbolizing the corresponding mnemic sensations. And in both cases the printed notes correspond with the sensations and stimulations with respect not only to the relative durations of the separate sensations, but also to the qualities of which pitch is the most important.

As a supplement to such a musical record, which represents only the synchronous phases of original sensations and their mnemic equivalents, we may refer to the schema which gives the acoluthic phase of original sensations (pp. 184–5) in relation to their mnemic reproductions (p. 202).

In all this we must not lose sight of the fact that only the relative, not the absolute, duration of a mnemic sensation corresponds to that of its original. I may recall a melody as quicker or slower in total pace than as I first heard it; an effect dependent on various accompanying factors. But if the engraphy is good, the relative temporal values, the correspondence in duration of a sensation or note to the duration of the preceding or succeeding sensation or note is fairly accurate.

The resulting rule can be formulated as follows: In the matter of spatial extension and temporal duration, together with intensity in its narrowest sense, a mnemic sensation only reproduces its original exactly in so far as it truly represents the relative, not the absolute, value of the latter. That is to say, the respective values of the mnemic and of the original sensation need not be identical; they correspond to the values of the remaining components in the same simultaneous complex as well as to the values of its predecessor and successor in a sequence of complexes.

The absolute values of spatial extension, also the

duration of intensity in the narrow sense, can vary within fairly wide limits in mnemic reproduction. In this case there is a proportional variation in the corresponding values of the remaining components of the same simultaneous complex of sensation, and in those of the corresponding members of a sequence of complexes—e.g. in the mnemic reproduction of a landscape one feature, say, a tree, may appear sometimes larger, sometimes smaller; but then there is also a proportional variation in the whole of the mnemically evoked landscape. I said in *Mneme* [1]: "The engram of any form can be ecphorized either greatly magnified or greatly reduced, according to the nature of ecphoric influences, of homophonous original excitations, or of co-operating associations. An example of this may be seen in the case of a sculptor or painter who is able to reproduce an original percept in different dimensions, but with perfect fidelity to the proportions. Most people unconsciously write smaller between narrow lines than between wide lines, yet, proportionately, the letters are a correctly reduced copy of the usual and characteristic hand of the writer. Proportional variation in size of handwriting may also occur, mainly as motor reaction, when writing with the eyes shut.

"In like manner a succession of mnemic excitations may proceed more quickly or slowly than the original excitations, without disturbing the original proportions between the members of the succession. Under the influence of a conductor beating time, or of a fellow-singer, or of a pianoforte accompaniment, or of emotions heightened by the stimulus of alcohol, a piece of music may be sung, consciously or unconsciously, in a much livelier tempo than previously." [2]

"Intensity" follows the same law. It is reproduced in combined mnemic sensations in all their reciprocal relations of value both as regards the simultaneous

[1] 2 Aufl: S. 361.

[2] Above quotation is from Mr. Louis Simon's translation of *Mneme*, pp. 266–7.—TRANSLATOR'S NOTE.

complex and the sequences of such complexes, but it does not necessarily represent the absolute values of the whilom original sensations.

The proportional variations of mnemic excitations were described in detail in the fourteenth chapter of *Mneme,* and I dwelt on the importance of this theme especially in cases where proportionately changed excitations exhibit themselves not in sensations but in plastic reactions, such as the proportional increase or diminution of portions of organisms in processes both of growth and of regeneration, which can thus be brought under the general mnemic laws. It is unnecessary to say more at present about this point.

What requires insisting upon is that the extensive and intensive[1] values of mnemic sensation need not absolutely coincide with their originals, although they usually approximate to these when no opposing influences prevail. As a rule, when we recall the head of a friend we do so in its life-size, neither bigger nor yet reduced to the size of a visiting-card photograph, unless an image in one or other of these two dimensions happens to be mnemically impressed upon our minds. Similarly, we "remember" a melody not only with its proper rhythm but also in the tempo in which we have heard it; moreover approximately with its appropriate "intensities." This shows that *even for absolute values standards are engraphically retained.* Anybody endowed with musical memory will recall a melody correctly not only as to rhythm but metronomically. His cyclical organic sensations (the importance of which I pointed out in reference to the non-reversibility of mnemic processes (*vide* p. 208) provide him, so to speak, with a good clock whereby he can always bring mnemic tempi into fairly correct relation with their originals.

A complex of organic sensations of another sort furnishes us with a certain scale of measurements for the absolute values of our spatial sensations. These

[1] "Intensity" is here to be understood in the narrow sense and not confused with vividness.

are primarily derived from our conscious or unconscious sensations in regard to the position and dimensions of portions of our bodies. Primarily these originate in the pressure of which we are sensible when standing, sitting or lying, also, in part from the reciprocal movements of our limbs. These sensations have become intimately bound up with the corresponding optical sensations. And as their characteristic signs are present in every original and every mnemic simultaneous complex, the homophony of the whilom original representative with its mnemic colleague forms a sort of fixed standard of absolute value for our mnemic spatial sensations.

As regards the "intensities" of original sensations consequent on the amount of applied stimulus, their relative values in simultaneous complexes and in sequences are engraphically stored up in the organism and mnemically reproduced. And to a certain degree the mnemic reproduction has all the intensity of the original sensations; the result being due to a peculiarity in the scale of intensity. For this scale runs between two fixed points, the point whereat a sensation is not perceptible and that whereat it becomes painful. Thus the pianissimo of an auditory sensation may be nearly imperceptible and the fortissimo nearly painful, while between the two the mezzoforte can again be divided into a simple forte or a simple piano, and so on.

It is clear that these marks of intensity have absolute validity within certain limits, and that when an original sensation has been felt it will be mnemically reproduced with its own characteristics. And this applies to other fields of sensation, at least as far as the principle goes, although there are some variations in the case of optical sensations.

All sorts of secondary helps often come into play in the finer shades of tone-intensity, but I cannot dwell here upon the many consequent complications.

The same principle governs the fact that, as always happens, not only the *relative* values of sensation are

faithfully reproduced but that under ordinary circumstances the *absolute* values are similarly repeated. The principle reposes on the engraphic co-fixation of a special standard, which, in mnemic reproduction, is immediately made to coincide with the corresponding original standard, and hence can be transformed into an absolute measure applicable to the values of all the other mnemic sensations. Spatial extension becomes measurable by the dimensions of one's own body; duration by cyclic organic sensations and "intensities," finally, by the fixed points of their own scale. From all this it follows that a proportional variation in the values of mnemic sensations can take place easily only within certain rather narrow limits; e.g. I can recall the face of a friend, not only life-size, but also larger or smaller han life. As regards the reduction I can continue it lmost indefinitely, because I have seen my friend's face at every possible distance and in every possible diminished form. But when it comes, at a certain point, to enlarging, difficulties arise, and only a few not artistically trained persons are capable of making correct likenesses of their near relatives in gigantic proportions.

A very musical individual has no difficulty in mnemically recalling again some well-known melody, at a quicker or slower pace, but finds this much less easy in the case of an unfamiliar tune, while a quite unmusical person may be entirely unable to recognise a hackneyed melody when played at a different tempo. Charles Darwin, in his autobiography,[1] speaking of his lack of musical capacity, relates this characteristic occurrence: "My musical friends soon perceived my state and sometimes amused themselves by making me pass an examination, which consisted in ascertaining how many tunes I could recognize, when they were played rather more quickly or slowly than usual. 'God Save the King,' when thus played, was a sore puzzle. There was another

[1] *Life and Letters of Charles Darwin, with a Chapter of Autobiography*, vol. I, p. 50, Francis Darwin. London, 1887.

man with almost as bad an ear as I had, and, strange to say, he played a little on the flute. Once I had the triumph of beating him in one of our musical examinations."

Persons unmusical to an unusual degree even have difficulty in recognizing a melody which they are accustomed to reproduce mnemically pianissimo when the same is played fortissimo, or vice versa. On the other hand, natural facility with, above all, practice suffices to dispose of such difficulties. A great painter can draw any figure he remembers in any proportion he chooses; a clever musician can play any tune he recalls in any tempo or degree of loud or soft intensity.

Let us sum up the results obtained from our exposition of all the facts connected with this question:

1. Only the *relations* as such of the original sensations are engraphically fixed in their values both of extent and duration and in their values of intensity (in the narrow sense of this word). Their *absolute* values are not necessarily retained.

2. Thence it follows that mnemic reproduction will possibly exhibit a proportional dwarfing or exaggeration of spatial and of temporal values as well as of "intensities" in the different simultaneous complexes and sequences of the same.

3. Meanwhile, owing to the simultaneous engraphic fixation of certain marks, there usually results a reproduction of approximately similar absolute values both spatial, temporal and intensive, so that the proportional enlargement or reduction of such *absolute* values has to overcome an appreciable if not very strong resistance. The frequent use of the capacity for dwarfing or exaggerating in mnemic reproduction renders this obstacle almost negligible.

It results from all this that a statement based on erroneous data is frequently made. It is asserted that, in comparison with its original direct sensation, a mnemic sensation is unstable and fleeting. This places

the basis of their reciprocal relations in quite a false light. For, as we have seen, a mnemic sensation has essentially and, as a rule, absolutely the same values as its original model, a fact obvious to anybody mnemically reproducing a well-known melody or a series of movements, and this is first and foremost the cause of the alleged "fleetingness." For the great majority of our original sensations are also of brief duration, being replaced in one fraction by fresh sensations, at least as regards their arrival at superliminal consciousness, so that while their vividness increases they are also pre-eminently the generators of engrams. It is not fleetingness which constitutes the difference between mnemic and original sensations, but something quite different, which may lead a superficial observer to the conclusion that an original sensation possesses greater stability. This is that an original sensation can in many cases be prolonged at will, at all events when the duration of the stimulus is so prolongable. I can look attentively at a figure for many seconds, can listen a long while to the murmur of a brook, a long while inhale the scent of a rose, and keep all this up till attention fails to stick to the original sensation, a weakening of the attention which occurs relatively very soon. Moreover, the duration of an original sensation is limited by the adaptive process which, especially in the olfactory sphere, shortens the efficacy of many stimuli. But, notwithstanding this restriction, the rule as regards original sensations is that they can be prolonged at will by continuance of the stimulus creating them, so that from the outset no fixed term can be set to them. Mnemic sensations, on the contrary, are confined from the beginning within the time-limits of their originals. No amount of attention avails to prolong them. They vanish when their pre-determined duration is over, and there is no means of reviving them except by ecphorizing them anew. *Not in their briefer, but in their predestined, duration must we seek for the characteristic feature of mnemic processes.*

Quite different is the shifting kaleidoscopic quality which the oscillations of imagination impose upon our mnemic sensations. In the outer world we are aware of a series of sounds and noises, but, presently, our attention is caught by a passing vehicle or for a minute diverted to a cooling breeze from the window, and then we set to admiring for a time a butterfly hovering over the flowerbeds in front of us. The situation is very different when, detaching ourselves from all before us, that is from all our original sensations, we direct attention exclusively to the mnemic ones. But it is only when these are acutely pleasant or unpleasant, or when we purposely rehearse a tune or a poem *engraved* on our mind, or fix our memory by an effort of will, that we can remain voluntarily attentive. As a rule, when attention is exclusively concerned with mnemic sensations it wanders capriciously through the most disparate strata of our engram-store; and this is natural since no outer circumstance is throwing its restraining weight into the scale, as it does when attention is claimed by original sensations. *But this wandering of thought is the effect merely of a particular state of attention and not of any change in the tempo, pace or duration of mnemic processes.*

The "wanderings" of fever-patients or the insane is caused far more by the great unsteadiness of attention to their own sensations, and especially to their mnemic sensations, than to any particular "speeding-up" of these sensations themselves. The same can be said in a contrary sense when attention is only directed with an effort to a new mnemic field, when it "sticks" and thus hinders rapid ecphory, as happens in cases of exhaustion, poisoning (especially alcoholic poisoning) and many pathological phenomena. It is undeniable that in such cases the tempo of the process is often altered; but this entails no change in our point of view since, as already said (*vide* our second principle, p. 238), even under normal conditions a proportional diminution or increase in the temporal values of mnemic

processes is possible. There is therefore no contradiction between our basic thesis and the pathological facts of sensation, and we can consequently spare ourselves any long disquisition upon these phenomena and defer to a later work on the pathology of mneme any investigation of them and of the interesting experiments made by Dietl and Vintschgau and, especially, by Kraepelin and his pupils.

FOURTEENTH CHAPTER

GENERAL VIEW OF THE HOMOPHONY OF MNEMIC SENSATIONS

IN the fifth chapter we went fully into the homophony of original sensations; and we naturally start from the result of those researches when turning now to the homophony of mnemic sensations among themselves, relatively to their original and mnemic production.

It is therefore well to sum up anew the achieved results. We understand by homophony the peculiar reciprocal relation in which sensations, qualitatively similar and manifested in the same fields but differing in the manner of their simultaneous production, act to one another. When appearing together in the same field of sensation, they do not fuse into a third or medial phenomenon, but (1) their similar components are, so to speak, superposed, so that while there is, as a rule, no notable alteration in *intensity*, there does result a not insignificant increase of their vividness.

(2) In the case of homophony their dissimilar components become more or less definitely antagonistic among themselves and often cause sensations of a particular kind which we shall describe as differentials of sensation.

(3) In many cases experiments have proved that excitations made manifest by homophonous sensations run their course without fusion even when their components are similar (see, for instance, Sherrington's experiments with flickers of light, and researches by others into the direction of sound).

These conclusions are directly derived only from the study of the homophony of original sensations among themselves, of which examples, easily verified, are binocular sight, di-otic hearing, or the act of smelling by means of several olfactory cells. The question then arises, Can a mnemic and an original sensation-complex be homophonously superposed?

From all that we have said hitherto it is obvious that the conditions for the production of homophony between two complexes of sensation, one original and the other mnemic, are always present whenever, through the partial return of original components, an engram-complex is ecphorized. Let the original complex A (or) ecphorize the engram-complex A (engr), B (engr), C (engr), and obviously we get the necessary conditions for homophony between A (or) and A (mn); and this homophony I shall express by the formula $H\begin{pmatrix} A\ (or) \\ A\ (mn) \end{pmatrix}$ to which I will devote some further remarks on page 249.

Take yet another example. A mnemic sensation-complex C^1 (mn) is ecphorized on a groundwork of successive association and in its turn ecphorizes a very similar mnemic complex which belongs, however, to another engram-layer C^2 (mn); here again we clearly get the necessary conditions for homophony $H\begin{pmatrix} C^1\ (mn) \\ C^2\ (mn) \end{pmatrix}$. But what we must now see is whether the presence of such conditions also produces those peculiar characteristics of homophony which we have described by saying that the two sensations do not fuse to form a third intermediate one but set up a kind of antagonism between the dissimilar components of both complexes, while their similar components are rendered more intense, but not more vivid, through homophony. What we shall find is that when there occurs such a constellation as the one described above, the characteristic phenomena of homophony among original sensations also appear, but that, further, in mnemic homophony there are observable

a number of additional phenomena which confirm our view of the nature of the process.

I will now adduce two examples of the constellation through homophony of original and mnemic sensations as well as of mnemic sensations among themselves, and then proceed to a verification of facts corroborating the different above-stated points of view.

To illustrate homophony between an original and a mnemic sensation I will select an experience of my own, which is remarkable merely by its comparative simplicity. But as homophony of such sort happens for each of us nearly every moment of our waking hours, every reader should be able to recall analogous examples for himself. When in Berlin some seven years ago I saw, exhibited, a long-lost and only-just-recovered picture by Rembrandt: "David playing the harp before Saul." This picture impressed me strongly, constituting as it did for me a quite new original complex of visual sensations. I studied it attentively and thereby gained a clearly defined engram-complex. As I saw the picture well but only once and for a short time, as I never came across reproductions of it and, as far as I know, never thought of it nor read about it afterwards, it must be assumed that a single but profound engram-complex had sunk into me.

In September 1907 I went to The Hague and there revisited the (to me) well-known Mauritzhaus Gallery. Quite unexpectedly my eyes fell upon a picture by Rembrandt, in which at the first glance I seemed to recognise the "David playing before Saul" which I had seen in Berlin. But no! Was it really the same? And how came it to be here? The colouring seemed to me less warm and brilliant; and the expression of the weeping king, as he hid his countenance in the folds of the curtain, less poignant. Yet it was otherwise exactly the same picture; the same attitudes, the same David, the model for which Rembrandt had doubtless picked up before his own door in Brustraat. Was the present picture only a copy? A copy in the Mauritzhaus

Gallery? Impossible! I could not solve the riddle, and asked an attendant, who assured me it was in fact the picture once exhibited in Berlin and some time previously bought by the Royal Picture Gallery of The Hague.

But, then, whence my doubt—my hesitation? Evidently, these arose from a lengthy comparison, with alternate results, between the original sensation-complex and the mnemic one it had ecphorized—in other words, from a homophonic comparison. The conditions for homophony were present in so far as every particular component of one complex was derived from the same field of sensation as each particular component of the other complex, with which it either fused or partially clashed; or, in other words, each complex as a whole occupied the same space in the field of sensation as the other. But that there was never a half fusion of the two sensation-complexes but, on the contrary, a certain degree of antagonism between them was evidenced by the consciousness of alternating likeness and unlikeness between the two congruent images.

The difference between two impressions, the formation of these differentials of sensation, can be examined only later, and at present we can only touch briefly on the question, How, in a case like the above, a difference between the two pictures in colouring, expression, and so on, came to be perceived? Was it really the same picture which now made a new original impression and formerly deposited the engram out of which the mnemic sensation was ecphorized? Were the colours of the picture not the same in Berlin as in The Hague?

Every psychologist would reply that they were certainly not the same, since the pictures were not equally well hung in both places. The original sensation-complex in Berlin differed from that of The Hague quantitatively because of difference in the amount of illumination and qualitatively because of different incidence of light-reflections and also different play of contrast by surrounding objects, let alone differences in mood and

other mental factors affecting my eyes, my brain, my whole ego on the one occasion and the other. Even the fact that the expression of the weeping king had impressed me more deeply in Berlin than in The Hague is certainly attributable to the much less favourable hanging of the picture in the Mauritzhaus, where it suffered from confusing reflections which made the finest shades of expression in the physiognomy more difficult to detect. This instance of homophony between the original sensation at The Hague and the mnemic sensation acquired at Berlin is a well-ascertained fact, nor did any error enter into it in so far as it emphasized particular differences despite general agreement in the two impressions. The whole matter can be expressed in the following formula: $H\begin{pmatrix} A^2\,(or) \\ A^1\,(mn) \end{pmatrix}$.

From the above example of homophony between an original and a mnemic sensation let us pass to an equally simple case in which there is homophony between two mnemic sensations. Let us suppose that after my visit to The Hague Gallery what happened there was never remembered by me until this present moment. The reality would be rather more complicated, but as the complications cannot affect the essential point, they can be left out of account.

Let us suppose that while far away from Berlin, where I first saw the picture, and from The Hague, where it now is, I shall find myself able to see it in my mind's eye in a lively and unified manner so as to be able easily to describe it in most of its details. Suppose that I am, nevertheless, able by a shifting of my attention from one to the other to evoke alternately the memory-image left, first by the Berlin experience and then by The Hague experience, or vice versa. Then I shall be able to bring under comparison the two memory-images or mnemic sensation-complexes and become aware of their similarities and dissimilarities just in the same way that when at The Hague I brought under comparison the original sensation-complex I was then experi-

encing and the *mnemic* sensation-complex I had brought from Berlin. We should then have nearly the same homophony formula as at the Hague, viz.:

$$H\begin{pmatrix}A^2\,(mn)\\A^1\,(mn)\end{pmatrix} \text{ instead of } H\begin{pmatrix}A^2\,(or)\\A^1\,(mn)\end{pmatrix}.$$

The sight of a photographic reproduction of the picture would produce a new original and mnemic homophony: $H\begin{pmatrix}A^3\,(or)\\A^2\,(mn)\;A^1\,(mn)\end{pmatrix}$ and from the engram deposited by A^3 (or) a later ecphory would result in the homophony H (A^1 (mn), A^2 (mn), A^3 (mn)) without any repetition of the original sensation.

The reader will observe that I have just written the homophony formula differently from before in order to dilate upon the two separate principal forms of homophony, which the mode of writing them will also serve to distinguish. To this mode of writing I shall dedicate a few words later on.

Let us start once more from the concrete case. Suppose I recall to memory the picture seen once in Berlin and once at The Hague, so as to describe the occurrence in question to somebody, together with the figures in the picture, their posture and costumes. I pass over the small differences in the two mnemic complexes of sensation, and neglect these naturally, all the more if in the interval I have bought a photograph of the work and, having looked at this, say, two or three times, have thereby acquired three new and strong engrams. A new ecphory will then produce in me a homophony of mnemic sensations as follows: A^1 (mn) = Berlin engram; A^2 = The Hague engram; A^3 (mn) A^4 (mn) A^5 (mn) = engrams produced by successive considerations of the photograph. In such a homophony there results, as a rule, no opposition of one component to the others, no creation of differentials of sensation, but, on the contrary, the distinctions between the various homophonous components are suppressed. I shall call this a *non-differentiated* homophony, and write its formula in

one line, thus: H. A^1 (mn), A^2 (mn), A^3 (mn), A^4 (mn), A^5 (mn).

But in partial contradiction to the above remarks, are cases in which a differential of sensation is formed.

Such a differential is always the result of an antagonism between two components or two groups of components. This I describe as a *differentiating* homophony and write its formula in two separate lines.

Whether in a given case a differentiating or non-differentiating homophony takes place, depends in the first instance upon the direction of attention, but also upon other conditions. For instance, I have heard Siegmund's song " Winterstürme " from the " Walküre " about a dozen times, and when I think of it there sounds, as a rule, in my mind a mnemic series of tones so free from the details of the various performances that I might almost call it abstract and such that I can only formulate as H (B^{1-12} (mn) . . .). But if I go on to think " I never heard it sound so powerful as when I first heard it sung by Niemann " then the homophony will be differentiated and formulable as $H\begin{pmatrix} B^1 \text{ (mn)} \ldots . \\ B^{2-12} \text{ (mn)} \ldots . \end{pmatrix}$. The second row of this formula shows at once that in differentiated homophony each of the two contrasted components can be the product of undifferentiated homophony.

Where there is a contrast between two components or two groups of components in homophony, that is where a differential of sensation is formed, the two-row formula should, I suggest, be written by preference. Consequently, to return to the example of the Rembrandt picture (p. 244), I shall now write $H\begin{pmatrix} A^1 \text{ (mn)} \\ A^2 \text{ (mn)} \end{pmatrix}$ when referring to the partially contrasted impressions made on me respectively in Berlin and The Hague. But when, on the other hand, by eliminating all differences I simply re-memorize my impressions in the shape of a whole sensation-complex, that is when I pay attention only to the principal points of the aforesaid picture on being

required, let us suppose, to describe the whole procedure exactly, then I should write my formula thus: H (A^1 (mn), A^2 (mn)).

The two-row formula $H\begin{pmatrix} A^1\,(mn) \\ A^2\,(mn) \end{pmatrix}$ to express contrast between two homophonous sensations or groups of sensations was hit on by myself independently, and only much later did I find that Höffding had used a similar mode of notation to describe recognition.

In his *Psychology*[1] he writes: "This middle position between sensation and re-presentation can be theoretically expressed by saying that in recognition there is an element of re-presentation and one of sensation. If we describe the latter as A and the former as *a*, then recognition can be expressed by ($A \times a$) or $\begin{pmatrix} a \\ A \end{pmatrix}$, for all the bracket means is that by a process of abstraction we separate elements which in reality are not divisible."

A careful study of Höffding's works[2] shows, however, that in his manner of writing his formula he was far from representing the concept of homophony or, indeed, from understanding the peculiar position of opposition between two sensations implied in recognition.

His formula seeks rather to show that the particular state of consciousness in recognition is due to two conditions of which, taken separately, one would lead to the mnemic sensation (*a*), the other to the original sensation (A). But in the state of consciousness referred to, these two elements are supposed by him to be merged in one indivisible quality, one inseparable whole.[3] He not only insists upon this entire fusion into one whole of the two sensations, but extends it to cover

[1] Third German edition, 1901, p. 168.

[2] H. Höffding *Psychologie in Umrissen*, 1st German edition, 1887, 3rd German edition, 1906. *Über Wiedererkennen, Assoziation und psychische aktivität.* Viertaljahrschr. f. Wissensch. Phil: 4 Artikel im 13 und 14 B[d] 1889-90. *Zur Theorie des Wiedererkennens.* Wundts Philosoph. Studien 8 B[d] 1893.

[3] Höffding, 1893, S. 90.

the physiological processes of excitation manifested through the two sorts of sensation (original and mnemic).

His views are expressed as follows: "What I express theoretically as the fusion of a sensation with a re-presentation is the change which a sensation undergoes through repetition.[1]

"How a man thinks; what it is that, physiologically speaking, happens in the smallest portion of the organism, in this case the brain, that is an event *sui generis* into which we have not to inquire further here. The natural assumption would be that through the first impression a transposition of molecules took place which, when the impression has ceased, is replaced by the original state, but with the difference that this is now less stable and easier to be thrown out of equilibrium. So far then it can be said that a certain tendency to transposition has been generated and is more likely to recur when the same impression happens again. Recollection, or rather the faculty of recognition, is then a psychological correlate of the greater facility with which a change in the position of specific cerebral molecules occurs."

Höffding[2] goes on to to a further development of his thesis. From these passages it is clear that with his formula $\binom{a}{A}$ Höffding is not seeking to express a real process of homophony, a true coexistence of two separate excitations, and I have gone into so much detailed explanation in order to make it impossible for any reader, through a mere likeness in the manner of writing, to confuse Höffding's views with mine.

The essential difference between the two conceptions is as follows: According to Höffding recognition $\binom{a}{A}$, as, for instance, on seeing again in The Hague the Rembrandt once seen in Berlin, constitutes only one excitation-process (speaking now merely of the physiological side of the process), which on the second occasion is set up more easily than on the first because the path

[1] Höffding, 1889, S. 453. [2] *Vide* S. 432–3.

is, so to speak, made for it. In his view recognition is the psychological correlative of the greater ease with which a change in the position of the brain molecules involved is brought about.

I, on the contrary, believe that in such a case and in all related cases two separate processes of excitation can be shown to occur—processes which, as I express it, run side-by-side a homophonous course. And I strongly suggest that this is not a more or less arbitrary assumption but is susceptible of experimental proof, the facts being entirely opposed to any fusion of excitations.

Next as regards the homophony of two original sensations, a clearer proof still of the non-fusion of excitation-processes set up, e.g. in the right and left eye, is furnished by Sherrington's experiments on flickers reported at page 115. Perhaps a similar experimental proof could be found for sensation in the right and left ear; but it may also be that such an acoustic experiment cannot be made with any precision owing to the bony connections which prevent any adequate limitation of given stimulation-effects first to one ear and then to the other, a limitation which can easily be accomplished in the case of the eye. But the fact that we are able to decide whether a sensation of tone provoked in the right ear is louder than in the left, or vice versa, is good presumptive evidence that no fusion of two excitations takes place.

Turning now to what I describe as homophony between an original and a mnemic sensation or between two mnemic sensations, I have already tried to show by the production of conflicting impressions on my second seeing of the Rembrandt picture (p. 244) that our state of consciousness under such circumstances negates all notion of there being a simple fusion of sensations. In asserting such a fusion Höffding evidently never even thought of differential perception in this connection. But that there is no fusion of the excitations made manifest by sensation in cases of mnemic

homophony seems to me to be put beyond question by the fact that, whenever such homophony occurs, we have only to fix our attention on one of the components in order to be aware of it with the greatest clearness, free from all mixture with its fellow-components. How could such a distribution of homophony, such a, so to speak, selective "preparation" (like an anatomist's) of one or the other distinct component be possible if the excitations arising in the cases in point were to undergo fusion?

Thus I can always recall the mnemic image of the impression received at The Hague without any admixture of its Berlin counterparts, and, similarly, the fixing of my attention on the latter enables me to eliminate the former. And anyone with a good musical memory can easily recall mnemically a melody heard a hundred times and reproduce exactly the manner in which it was trumpeted twenty years ago by singer X or rendered ten years ago by singer Y in his "solid" way, or two years ago enhanced by the incomparable sweetness and richness of the voice of singer *Z*.

FIFTEENTH CHAPTER

THE REPETITION OF EXCITATIONS AS GENERATOR OF THE CONDITIONS FOR MNEMIC HOMOPHONY

FOR the full understanding of the facts brought together in the preceding chapter it will be advisable to explain *the significance of repetition* in building up the individual engram-store in its general connections. To this task, therefore, we will now address ourselves. The consequences to be deduced for the understanding of homophony will follow of themselves. First, we will ask, How does the repetition of an original excitation act? then, How does the repetition of a *mnemic excitation* act upon the construction of an individual engram-store?

As regards the repetition of an original excitation, the answer can easily be given.

Let us recall the example of the twice-seen picture by Rembrandt, which shows the possibility of obtaining by a mere effort of attention an absolutely clear and separate mnemic reproduction at one time of the impression received in Berlin, at another, of that made on me at The Hague; a fact proving that each of the two original excitations left behind it an entirely independent and distinct engram.[1] The same applies to the succession of

[1] The impression made at The Hague, or, as it is a question of a longer observation, more correctly the results of that impression, is certainly not exclusively a legacy of the original excitation (A^2 (or)) but, in accordance with the assertions above made, it is the legacy of a differentiating homophony $\binom{A^2\,(or)}{A^1\,(mn)}$. But this mnemic conflict asserted itself only temporarily during the contemplation of the picture. The greater part of the time I

engrams left respectively by the singing of the same melody twenty years ago by X, ten years ago by Y, and two years ago by Z, as well as all other engrams similarly deposited in the intervening years, although these last-named engrams were perhaps less vigorous and their mnemic sensations consequently less susceptible of being disengaged from the general mass by the fixation of attention. 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.

It might be here objected to me that, in any case, there must be a difference between mnemic sensations which arise out of only *similar* engrams deposited in separate layers. But this does not prove that such mnemic sensations can be differentiated when a repetition of the original excitation is not immediately distinguishable from that of its predecessor. Perhaps in this case no new engram is formed, but only the already existing one is reinforced. That our rule as to the creation of an independent new engram as integral component of a new simultaneous complex holds good even when the new sensation (i.e. excitation) is not distinguishable on repetition from its predecessor, is a rule which we can extend even to cases wherein what is repeated is not a new original, but a mnemic, excitation. I will now prove this by a small series of observations made in my own person, and which anybody can repeat for himself, introducing changes in detail suitable to his own environment. This proof, I premise, must be carried out in a manner somewhat different to that adopted in the cases already explained where the engraphic excitation manifested in the repetition is markedly distinguishable from its predecessor.

naturally gave myself up to the original sensations without any reference to the earlier impression, and so I obtained an independent new engram (A^2 (engr)), which was not essentially affected by the momentary intercalation of the differential engrams $\binom{A^2 \text{ (engr)}}{A^1 \text{ (engr)}}$.

Let me create a practically new optical engram-complex arising from an original sensation-complex when pulling out from my study table the left-hand drawer of two rarely opened ones, and taking in attentively a general picture of its contents. These consist of all kinds of photographic utensils, little cases of lenses, an exposure-plate, a paintbrush, an indiarubber squeezer for sticking photographs, a long-shaped cardboard box which once contained films, and so on. All this lies distinctly arranged before me, and so fairly fills the optical portion of my actual sensation-complex.

When I close the drawer again I shut off at the same time the whole simultaneous sensation-complex, which thus turns into a definite layer of my individual engram-store, of which I will mark the optical portion with a B.

After a while I proceed to pull out the right-hand drawer and regard its contents in turn. These are formed, to the left, chiefly of glass tubes, the top one fairly big; to the right, of black and red indiarubber bands of different thicknesses. I carefully consider this picture in its topographical details and close the drawer again. There remains behind from the whole excitation-complex an engram-complex which now forms a layer of my engram-store, the optical portion of which I designate E.

After a time I proceed as follows: sitting with closed eyes at my study table, I ecphorize (by a special fixing of attention) the image of the cardboard box of films out of the engram-complex B, and immediately attach to it the image of the biggest glass tube out of the engram-complex E. These two images, which are naturally mnemic sensation-complexes, I put into topographical contact at right angles, so that, for instance, they are made to form a kind of T. By an effort of attention I keep them united for a while, and eventually, when the image so constructed begins to fade, I hold it fast by renewing the ecphory. Finally, I let it go and it disappears. The simultaneous engram-complex resulting from the experimental combination thus made I will designate G.

By corresponding ecphorizing processes I can now convince myself that both the cardboard box of films and the biggest glass tube enter as engrams into two different engram-complexes, and each time present themselves in different topographical positions. The cardboard box is first in engram-complex B beside the paintbrush and the rubber squeezer, and next in the same engram-complex it is associated with the glass tube. Similarly, the glass tube is at one time in engram-complex E, together with the thinner tubes and the rubber bands, and then in engram-complex G in association with the cardboard box of films.

My contention is that in the engram-complex G a new engram of the cardboard box and the glass tube is present, and, quite independently of the same items in complexes B and E, has entered into a new permanent combination. It may be objected that the union thus formed is only one between the cardboard-box engram of complex B and the glass-tube engram of complex E in their capacity of components of these two engrams. But the simplest observation will demolish this contention. If I ecphorize complex B, I see the cardboard box in its proper topographical relation to the remaining components of the image of the left drawer, without the addition of the glass tube. And should the latter once arise, then in the same moment the paintbrush, the rubber squeezer and the remaining contents of the drawer disappear, and what persists in the mnemic field of vision is only the figure T. The same happens with the glass tube. The three optical engram-combinations B, E and G are in a way shut off from, and independent of, one another, in spite of the connection between them, which consists in the fact that the ecphory of one under certain circumstances acts ecphorically on one of the two others. When I ecphorize the T-formed combination of cardboard box and glass tube, I do not repeat in any way the process which I carried through when the engram-complex G took place. For when first uniting the cardboard box with the glass tube my attention had carefully

to shut off from the new combination forming the simultaneous complex G all share of the remaining elements of the engram-complexes B and E. But the union once accomplished, the ecphory of the simultaneous complex G no longer requires any act of attention to eliminate from the T-shaped combination of box and tube all the other components topographically combined with the box in complex B and the tube in complex E. For if these happen to emerge the T combination vanishes at once, and what appears is either the image of complex B or that of complex E. Anyone with a tolerable faculty of remembering and power of concentration can be convinced of the justness of my conclusions by making similar experiments himself. And I will here adduce another example which, *mutatis mutandis*, anybody can confirm by his own experience without an experiment *ad hoc*. Say, I witness the horrifying sight of a person run over by a tramcar. I exclaim inwardly, "How dreadful!" And whenever I recall the circumstance to mind this colourless remark repeats itself regularly, and in relating the event to anyone I never fail to add: "When I saw it, I said to myself, 'How dreadful!'" Each of these words is embedded a thousandfold in my engram-store; there is nothing new or special in the combination, and it is not easy to understand why they are so firmly, so isolatedly and precisely united with the other components of the accident's synchronous complex, unless the engram they form is not a new and, in a certain sense, at isolated product of that one moment.

Of course, this important question can be subjected to a much wider experimental and statistico-experimental treatment, especially on the lines of investigation sketched above for the cardboard box and the glass tube; but the final result will remain the same. For every thoughtful man has made the experiment again and again. Moreover, our creative thought, our inventiveness and constructiveness, etc., are based on a partly conscious, partly unconscious, combination of isolated components from widely differing layers of our engram-store. But when

this combination is once accomplished it presents a finished and comparatively independent product which on every new occasion does not perhaps require to be again put together, nor, what is more important for our argument, to be freshly cut off from *the adhering joint components of the respective various engram-stores.*

But such an independent combination only persists as long as it is a new engram, and not when there is only a uniting and freshening up of old engrams scattered throughout every imaginable number of layers. The newly created engram-complex is, then, an integral portion of the synchronous engram-complex with which and inside which it was born.

To put it briefly: *Every mnemic excitation or homophonous series of mnemic excitations*[1] *generates, as a component of the simultaneous complex in which it has been ecphorized, a new engram out of which an independent excitation separable from the parent engram can be ecphorized.*

The above only re-states and reinforces our first mnemic principle, viz., all synchronous excitations inside an organism combine into a connected simultaneous excitation-complex which, as such, acts engraphically in its turn, leaving, that is, behind it a connected and, in that sense, a whole engram-complex. We saw in the twelfth chapter that, setting aside differences in the manner of evoking it, there is no essential distinction between an original and a mnemic sensation, nor between the original and mnemic excitations which sensation implies. Under the term "all synchronous excitations," used in our first mnemic principle, original and mnemic excitations are included equally. The united synchronous excitation-complex, whether its components are set free by other stimuli or are ecphorized as engrams, persists permanently as an engraphic whole, that is, it sinks into some still blank portion of the stimulable substance.

As I have said many times in *Mneme* and elsewhere, I

[1] Further on I shall go into the engraphic action of homophonous series of excitations.

consider it premature in the present state of our knowledge to describe as "molecular" the material change left in the stimulable substance by the extinction of an excitation, or to seek to penetrate the manner in which the material change which we call an engram results from the energetic process of excitation. At present the special character of the said energetic process is almost entirely enveloped in mystery, and therefore the greatest reserve is desirable as regards this problem. But without abandoning this reserve I should like to show in what way the undoubtedly existing, but for us still mysterious, mechanical relation between engram and excitation is certainly *not* constituted.

Widely spread among physiologists and psychologists there is a certain hypothetical, symbolic notion of the relation between engraphically acting excitation, engram and mnemic excitation. I describe this again in the words of Höffding:[1] "The natural assumption would be that through the first impression a transposition of molecules took place which, when the impression has ceased, is replaced by the original state, but with the difference that this is now less stable and easier to be thrown out of equilibrium. So far, then, it can be said that a certain tendency to transposition has been generated." This sounds very plausible, and most of us would say that we have more or less imagined the mechanism of remembrance as something like this. I, at all events, did so until going more deeply into the matter, but after that I recognized that the process thus imagined is an impossibility. For if the stimulable substance is to be regarded, in respect of original excitation, of engram and of mnemic excitation, as something like an elastic rod which at first can only be bent with difficulty but, after many attempts, while still resuming its uprightness, requires less effort to bend, and if a mnemic process is similarly conceived of, then what is absolutely incomprehensible and even unthinkable is the production, as above proved, of a new engram severed from its parent when ecphory of the latter has taken

[1] *Ibid.*, 1889, S. 432.

place. For 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, identical in kind but differently determined, such as the mnemic process obviously results in. This seems to me to prove beyond dispute that the conception of an engram as a mere deepening of channels is obviously at variance with certified facts.

I would here point out that this particular quality of the stimulable substance—its property, in the case both of original and mnemic excitations,[1] of retaining an alteration, a synchronous engram-complex, and of transposing its chronological sequence into any spatial arrangement—that this singular property of the sensitive substance is at the base of our whole conception of time. It would take too long, however, to enter closely into this question here and to follow up the interesting consequences involved in it. Perhaps I may return to it later on.

I will only indicate in this connection yet another important point. I spoke just now of the particular property which the stimulable substance has *of transposing and retaining the chronological sequence of an engram-complex into any spatial arrangement*, so that, as I said, every synchronous engram-complex becomes fixed for good as a whole upon some blank portion of the stimulable substance. That is to say, certain structural changes of the organic substance, which we describe as engram-complexes, must have a local habitation, since out of them, from moment to moment, the engram-store is accumulated.

This, as we may call it, chronogenous localization

[1] Of course, various excitations are not subject to the engraphic process in the way that they would be if separately produced, but only come under it in their conjunction as members of a synchronous complex, and are consequently modified by the various influences of reinforcement by contrast, weakening to the point of neutralization, fusion, homophony and differentiation. I shall return more closely to this point when finishing my explanations of homophony at the end of the seventeenth chapter.

of the engram-store is altogether different from that localization of sense-spheres which up to now we have studied exclusively. This latter kind of localization (which I would distinguish from the chronogenous form because of its origin, and describe as *topogenous* in accordance with its special topographical configuration in the central organ) has been described at length in *Mneme.*[1] I there tried to show that the said localization was in no way an exclusive, but a gradual one, and I further indicated how its conditioning should be envisaged. To this point I will not here return, but will explain it more at length in a subsequent continuation, demonstrating how untenable is the view that the place in which original excitations develop in the brain is different from the seat of mnemic excitations. The reasons given for assigning a distinct locality in the cervical cortex to original sensations and "memories" respectively are very weak and break down on closer investigation. This will afford opportunity for a thorough examination of the chronogenous localization, showing that its march abreast with the topogenous one offers no difficulty.

It should be here remarked that the chronogenous localization of the engram-store must not only be accepted as a necessary postulate of the psychological and physiological facts set forth above, but that, like gradual topogenous localization, it can also be proved pathologically. Acute injuries of the nervous system, such as concussion of the brain, high fever, and so on, not only induce a pathologically changed condition of the engram-store from the inception of the injury to its cure, but this change also affects retrospectively the portions of the store laid down before the accident and, up to then, entirely normal. Those layers of engram generated immediately *before* the accident are the most seriously injured, that is, as the later course of the illness shows, they are not destroyed, but entirely or almost entirely deprived of their power of ecphorizing. The layers farther off from the accident in time, that is, those deposited

[1] 2 Aufl; 1908, S. 158–72.

longest before it, are those which change least, and the older layers whose production has preceded the accident by months are only sensibly altered in a very few cases. The healing of the injury proceeds in an inverse direction. The layers farthest off in time, then those nearer and nearest to the accident, become in turn ecphorizable. In his interesting work on *Disturbances of Memory*,[1] Ribot first drew attention to the significance of these particular facts and derived from them his "Law of Regression." A specially remarkable instance was noticed by Forel and reported by Naef in the *Zeitschrift für Hypnotismus*.[2] It was a case in which engram-layers laid down months before the illness became quite incapable of any process of ecphory. Such a pathological instance of "regressive amnesia," as well as the manner above detailed in which gradual recovery ensues, clearly proves a certain chronogenous localization of the engram-store. This is a point which will be more closely dealt with in the *Pathology of the Mneme*

[1] German edition, 1882.

[2] See also, in detail, A. Forel's *Der Hypnotismus*, 5th edition, 1907, S. 215–33.

SIXTEENTH CHAPTER

MANIFESTATION OF NON-DIFFERENTIATING HOMOPHONY. ABSTRACTION AS A RESULT OF HOMOPHONY

THE chief result of our investigation in the preceding chapter consists in recognizing that (as we shall see in due course) every repetition of an excitation, whether of original or mnemic nature, leaves behind it a corresponding new engram of latest date, which embeds itself in the previously formed synchronous engram-layer and, when a new ecphory takes place, associates itself homophonously with its predecessor. Thus is explained the extraordinary action of repetitions upon the completion of mnemic performances.

For with the number of homophonous contemporaneous sensations, we saw that what increases in the great majority of cases is not the intensity in the strict sense but is always, and to a remarkable extent, the vividness of the joint homophonous sensation. Any impression made on my optical sense by an object to which I am entirely indifferent, which I see daily and to which I have, perhaps, never paid any particular attention, nevertheless, through the number of repetitions, acts on me so that the smallest change in the object strikes me that I recognize it again after many years and, if I possess a good visual memory, I can easily recall it before my mind's eye and much more vividly than something looked at more carefully but seen much less often. Only when isolated impressions have been acquired under exceptional circumstances, for instance accompanied by great pleasure or pain, can they be reproduced mnemically with the same vividness as the

impressions of quite insignificant things which have gained extraordinarily in memory through homophonous coincidence.

We can put it briefly that the greater the number of homphonous components of sensation, or rather, if we wish to express the genesis of these components, the greater the number of preceding repetitions, so much the more vivid, *cæteris paribus*, will be the joint sensation resulting from homophony.

There is a great mass of experimental testimony, to which I shall return further on, which, directly or indirectly, confirms the above. But no scientific apparatus is required for proof of what our daily experience so amply establishes, How shadowy, for instance, are most of our menmic sensations when we have to deal with *single*, rather remotely lying, impressions of objects of an indifferent nature! And how incomparably more vivid are the reproductions of the same when they have been made upon us not once, but many times, when we have received them not once but a hundred times in passing some unimpressive indifferent place.[1]

When it is a question of the homophony of purely mnemic sensations, as in the foregoing example, the increase of vividness following on increase in the number of homophonous components becomes immediately evident. The growth of vividness consequent on the homophony of original sensations among themselves has been fully explained in our fifth chapter, page 120. I remark it clearly in my own case when comparing hearing with one ear or with both, but the evidence is even more convincing when an olfactory stimulus is applied on one occasion to one nostril, and on another to both. On the other hand, an increase of vividness is not incontestably provable, when in addition to a powerful original

[1] I may remark that for the reasons given at page 250, I must altogether reject, as an explanation of the above phenomenon, the assumption that through repetition the engram already present is strengthened by a diminished "resistance," or that the channel already made becomes easier to traverse on each occasion.

sensation there are several, in fact, a whole group of, homophonous mnemic sensations.

Nobody will maintain that, given similar conditions, a picture seen for the hundredth time in a good light and sufficient proximity arouses a livelier sensation than when beheld for the first time. Nor is there any difference, in this respect, of vividness as regards a melody heard once or a hundred times. But this becomes intelligible when we take into account that the vividness of a well-defined original sensation is, as rule, so absolutely greater than that of a mnemic, or of a whole homophonous group of mnemic, sensations that the increase necessary to reveal the presence of such a group is too insignificant to be remarked.

The case is quite different when original sensations are of very slight vividness. As we showed above, original sensations of extremely slight "intensity" possess also only slight vividness, a correlation which, as we also saw, holds good in this simple form only for the lowest degree of intensity. An original sensation of such slight vividness gains in this respect to an extraordinary extent when reinforced by a stronger homophonous group of mnemic sensations, e.g. in a bad light we see the colouring of a familiar picture far more plainly than that of one near to it but unknown to us. And the same is to be said of distant, barely perceptible tones. As soon as we know what they mean, to what melody they belong they become clearer at once, the homophonous group of mnemic sensations being associated with the original. Similarly with only slightly vivid sensations of smell and taste. It would be a profitable and not too difficult task to treat this phenomenon experimentally, and to establish with greater definiteness the increase of vividnesss in barely perceptible original sensations due to homophony with mnemic ones.

We can, therefore, confidently affirm that in the sphere of sensation non-differentiating homophony is manifested everywhere by an increase of vividness. But it is also manifested by a number of objective reactions or, rather, in certain modifications of such reactions. This different

mode of manifestation, however, implies nothing special, nothing new; it is simply another expression of the same peculiarity.

Before going more closely into this matter, we must glance at the question of the decrease as well as the increase of vividness, on the one hand, on the other side of intensity, of the excitations. When we insisted that, setting aside the difference in production, a mnemic image differs essentially from its original only through its weaker vividness, this mode of expression must be taken as applying above all to the sphere of sensation.

Given the same conditions, a mnemic sensation is much less vivid than the corresponding original sensation. But what of the *excitations* which have manifested themselves through these mnemic sensations? Of course, the mnemic excitation which results in a sensation less vivid than an original one must itself be weak in comparison with an original sensation.

We have remarked more than once that a sharp distinction must be made between the vividness and the intensity of a sensation. Now various characteristics of the excitations manifested in sensation must, of course, correspond to this distinction, even in the physiological sphere.

As we saw, the weakness of a reproduced sensation in comparison with an original one is in its vividness, or if in its intensity, then only indirectly; and the same applies to the reproduced excitation. Moreover, in regard to excitations, we have to distinguish the correlate *of diminished vividness* from *the correlate of diminished intensity and to lay stress upon the first alone as being a characteristic of reproduction.* Fascinating as this subject is, it would lead us too far. Perhaps an opportunity of pursuing it may occur later. Here I can only point out that whenever in the following pages I shall speak of diminished *excitation* in reproductions this will imply the correlate of lessened vividness.

It is characteristic of homphony that it works against the weakening to which mnemic sensations and the connected excitations, in comparison with their originals

are exposed, e.g. suppose I experience the original, sensation-complex A (or), B (or), C (or), D (or), which in its dying down leaves behind it the corresponding engram-complex A (engr), B (engr), C (engr), D (engr), E (engr). Then later C (engr) happens to be ecphorized through the return of the original component C = C (or). The ecphory of the engram C (engr) implies that in addition to C (or), liberated by a direct stimulus, C (mn) has presented itself in the homophonous form H $\begin{pmatrix} \text{C (or)} \\ \text{C (mn)} \end{pmatrix}$. This happens because C (or) is "recognized anew." But the remainder of the engram-complex A (engr) . . . F (engr) is not ecphorized, that is no such ecphory is manifested. One often observes (and the observation is easy to verify experimentally) that when we are dealing not with an engram-complex generated only once but with a number of engram-complexes which co-ordinate homophonously, say, e.g. a chorus of 50 voices, the resultant effect is not the effect C^{1-50} (mn), but is B^{1-50} (mn), C^{1-50} (mn), D^{1-50} (mn), while in a chorus of 100 voices the effect produced will be A^{1-100} (mn), B^{1-100} (mn) C^{1-100} (mn) D^{1-100} (mn), E^{1-100} (mn). There is, in short, an ever more complete ecphory of the entire simultaneous complex. Moreover, we know that the ecphory of a simultaneous complex, or of a portion of it, necessarily involves, when the mnemic excitations are sufficiently strong, the ecphory of its immediate successor or a considerable portion of the same. And as the sum of vividness in the mnemic excitations grows with every addition of the homophonous chorus, this addition results in the facilitation of the successive mnemic processes.

In psychological literature all these relations are, as a rule, conceived and expressed in a different way. Instead of saying that the completion of the ecphory of a simultaneous complex and, in addition, of its successor increases when homophonous co-operating components are joined to it, emphasis is laid on what is the genetic conditioning of homophony, namely, on repetition of stimulus, i.e. of an excitation; and, while the utmost

possible completeness of the ecphory of a simultaneous complex is disregarded, the several components of a complex are kept exclusively in view, and repetitions are stated to favour the uprise of associations (or, rather, of ecphories on the road to simultaneous association) and to strengthen or fix these associations themselves.

This mode of stating matters, while it renders a portion of the facts, without, however, completely or rightly apprehending them, is due to not fully comprehending the true significance of the tendencies produced by several repetitions—in one word, the nature of homophony—in place of which most writers assume a process of facilitated redistribution, or of "deepening the channels." I have pointed out at page 259 the inadequacy of these views. What I regard as the essential reason in these phenomena can be summarized as follows: "Every mnemic sensation (or excitation) and every mnemic happening is, *cæteris paribus*, weak in comparison with their originals."

The mnemic sensations and happenings can be reinforced by frequently repeating the excitation, and the homophony implied in the ecphory of these engrams itself contributes to such reinforcement.

Here we enter upon a wide and interesting field which others have already explored experimentally with very good results, among which I have already noticed the fundamental principles obtained by Ebbinghaus.[1] He was the first to apply rigorous scientific methods to these matters; and he constructed a secure and fairly sensitive method of measurement in his "Esparniss-Methode," which he describes as follows:

"Take rows of numbers or words hitherto associated and get them by heart as far as the first reproduction, then examine what economy of repetition takes place in comparison with equal rows of words or numbers under similar circumstances, but between whose members there has been no association."[2]

[1] H. Ebbinghaus, *Über das Gedächtniss*. Leipzig, 1885.

[2] H. Ebbinghaus, *Grundzüge der Psychologie*, 2 Aufl., 1 Bd., S. 647. Leipzig, 1905.

Even better than this is the "treffer methode" of Müller and Pilzecker.[1] This consists in submitting a certain number of times to the subject of the experiment a row of words or numbers to be engraphically taken in and then showing him separate members which he is told to follow up with the consecutive members in their right place. The right hits are then counted and the time required for the appearance of the reaction is also exactly noted.

Ebbinghaus's "Hilfen" (Helps)[2] furnishes yet a third method which is, so to speak, the negative side of the "hits method."

In all these methods, however, the underlying principle is the same. It consists in ascertaining how frequency and distribution of repetition stand to completeness and rapidity of reproduction. These and other methods have brought considerable knowledge of these relations and of other points connected with them. Of course, such investigations only result in a more exact definition of facts already familiar to our daily experience, but which for purposes of teaching require to be established through such precise definition. New discoveries have also been made, but none approaching in importance those already carried through by Ebbinghaus in 1885, with reference to so-called accompanying and retrospective association.[3]

I may mention as particularly interesting the facts given by Ebbinghaus,[4] Jost,[5] Müller and Pilzecker,[6] and Lipmann,[7] in regard to the difference which varied distribu-

[1] G. E. Müller and A. Pilzecker, "Experimentelle Beiträge zur Lehre von Gedächtniss," *Zeitschr. f. Psychologie*, 1 Ergänzungsband, 1900.

[2] *Ibid.*, 1905.

[3] See above, p. 204.

[4] *Ibid.*, 1885, S. 121.

[5] A. Jost, "Die Assoziationsfestigkeit in ihrer Abhängigkeit von der Verteilung der Wiederholungen," *Zeitschrift f. Psychologie*, 14 Bd., 1897.

[6] *Ibid.*, SS. 232–43.

[7] Lipmann, "Die Wirkung der einzelnen Wiederholungen," *Zeitschr. f. Psychologie*, 35 Bd., 1904.

tion of repetition makes in the reproduction-resultant. Everyone knows that a poem is more easily learnt by heart when repeated to oneself for fifteen minutes, say, four times a day, than where one effort is prolonged for an hour. One is naturally inclined to attribute this merely to fatigue and wandering attention, because these influence so largely the vividness of original sensations and therewith the deposit of a strong engram. But Jost by means of ingenious experiments proved that these variables can be eliminated and that, despite this elimination, a distribution of the repetitions over a longish space of time, with consequent interruption of engraphy during the pauses, remarkably facilitate correct learning by heart. To my mind, these experiments prove beyond doubt that engraphic receptiveness of the stimulable substance, after a sensitive new engram has been produced by some definite excitation, is diminished for the time being with regard to a particular excitation and only recovers by degreees. The reader is aware that we attributed the influence exercised by repetition on the perfecting of reproduction chiefly to the creation of new engrams reinforced by a homophonous chorus. But as the engraphic receptiveness of the stimulable substance for a particular excitation only regains its original capacity after the lapse of a definite time from the creation of the engram corresponding to the excitation, such engrams are rendered ever more imperfect by continuous repetition of the excitation and can attain completeness only when the repetitions are interrupted by appropriate pauses.

Light might be thrown on many interesting facts if we continued these considerations, but, as requiring a broader basis of study and much material, they would lead us too far from the collation of our main data. I intend dealing in a separate work,[1] with the conditions necessary for engraphy to take place and, on the other hand, those by which it is jeopardized, together with the influences which may disturb or destroy already formed engrams, under normal as well as pathological conditions.

[1] *Pathology of Mneme.*

Less interesting for the principles with which we are here concerned is the otherwise important question whether a series of objects is more firmly engraved when offered to memory in part or as a whole ;[1] what effect rhythm has upon engraphic conservation and the facility for mnemic reproduction ;[2] and, finally how engraphy is affected, on the one hand, by a jumble of casual components and, on the other, by a significant combination such as necessarily entails both a number of ancillary associations and a co-ordination of the subject-matters ?[3]

For the aims of our present work these important questions, bearing as they do upon a very complicated interchange of varied influences, have no basic importance. Anyone desiring to make further acquaintance with them can turn to a useful criticism of them by Claparède,[4] Ebbinghaus,[5] and finally by Offner.[6] A bibliography was fully completed by Kennedy[7] up to the year 1898, and carried on from that date by Reuther,[8] and Claparède's small monograph contains at the end a good list of the appropriate literature.

This experimentation upon memory-processes has, however, always proceeded as if the repetitions consisted

[1] Lottie Steffens, "Experimentelle Beiträge zur Lehre vom ökonomischen Lernen," *Zeitschr. f. Psychologie*, 22 Bd., 1900.

E. Ebertt and E. Neumann, "Über einige Grundfragen des Psychologie der Übungs-phänomene im Bereiche des Gedächtnisses," *Archiv f. d. ges. Psychologie*, 4 Bd., Heft 1, 2, 1904.

[2] M. V. Smith, "Rythmus u. Arbeit," Wundt's *Philosoph. Studien*, 16 Bd., 1900.

G. E. Müller u. F. Schumann, "Experimentelle Beiträge zur Untersuchung des Gedächtnisses," *Zeitschr. f. Psychol.*, 6 Bd., 1894.

[3] See (besides Ebbinghaus, Müller and Schumann and M. V. Smith (*ibid.*)) Binet et Henry, *La Mémoire des Mots, La Mémoire des Phrases, L'Année Psychologique*, 1 Bd., 1894.

[4] E. Claparède, *L'Association des Idées*, Paris, 1903.

[5] *Ibid.*, 1905, pp. 633–724.

[6] M. Offner, *Das Gedächtniss*, Berlin, 1909.

[7] "On the Experimental Investigation of Memory," *Psych. Review*, § 477–99, 1898.

[8] Fr. Reuther, "Beiträge zur Gedächtnisforschung," Wundt's *Psychologische Studien*, 1 Bd., 1904.

in new, in original, excitations and sensations. Of course, this is the way to obtain the most vigorous new engrams and, in so far, the probability of an especially rich and a, therefore, efficient subsequent homophony. But the mere return of a mnemic excitation suffices, as we have already many times explained, to create a new engram and, with it, the essentials for homophony. All experiments in learning by heart show this to be the case; e.g., we all know that we memorize better by saying the words out loud. For the acoustic and kinæsthetic *original* excitations thus provoked deposit with each repetition correspondingly new engrams. It is true that when necessary we can also learn by heart silently, but the result, owing to the lesser effectiveness of the engram-creating excitations, is very much feebler. So far as I know, no experimental investigations have been made into this subject, for instance, by comparing an original with a mnemic excitation in regard to the creation of engrams and perfecting of mnemic reproduction. It would be an interesting task to formulate these comparative differences.

Before leaving the subject of the working of homophony (that is of the repetitions which genetically condition homophony) on the vividness of mnemic sensations and generally on the perfectness of menmic reproduction, I would anticipate an objection which might be made to my views.

The effect of repetition—as I think I have demonstrated —is above all to create new engrams; these when ecphorized are co-ordinated homophonously with mnemic excitations and so produce in their manifestations an increase in the vividness of sensations.

But is this not contradicted by the fact that the oftener a process takes place it becomes not only easier and surer in its action but also less striking and weaker in consciousness?

I could prove this by all kinds of mnemic processes which undergo more or less objective reactions and are made manifest in every sort of manner. I need only mention the poem intensively learnt and absent-mindedly

rattled off, the familiar tune almost unconsciously hummed or automatically played on the piano—all cases in which it would seem that homophony, or (to express oneself in genetic terms) multiplied repetition impairs the vividness of sensation.

But a conclusion so drawn would be altogether erroneous. The impaired vividness of sensation in these cases is not the immediate work of homophony, but is a secondary phenomenon of which the reason is not far to seek. For homophony, as already explained, produces in general an increase in the fullness and promptitude of reproduction all round. A homophonous multiple of mnemic excitations acts in the ecphoric sense with more energy on synchronously and successively associated engrams than does each corresponding single excitation. The stronger each unit of the homophonous contingent, the more easily and securely do all mnemic processes of excitation ensue. Just in proportion to this ease and security is the facility with which the process dispenses with attention, and all the more can the latter be turned away from it to other original and mnemic sensations so that at last those proper to the particular process of excitation can sink nearly or entirely beneath the threshold of consciousness. That is they *can* so sink but need not do so! For at any moment attention can revert and restore the sunken sensations to their normal strength. Consequently, the enhanced sureness of an excitation-process homophonously strengthened permits diversion of attention with its lessened output of sensation as a secondary result only, but in no way exacts it and can go on equally well with or without it.

In short, we have here again a case, such as can easily arise under certain circumstances, of the relation between sensation and excitation as described in page 63 of our first chapter. It sometimes happens that only a very imperfect insight into underlying excitation-processes can be obtained directly from the single sensation due to that process, because such a process is inferred not only from that particular sensation but also from other and not directly sensorized data.

The example we are considering shows that the activity of sensations heightened by homophony and ordinarily revealed by prompt and unerring reactions (motor and others) may under given circumstances suffer a temporary diminution and even disappear altogether. I repeat that it *may*, not that it *must*. My contention, that, conditions remaining the same, the vividness of sensations is heightened by homophony, can in no way be impaired by peculiar complexes of circumstances in which a decrease of attention (made possible only in the first place by homophony) has caused a change in the said conditions.

In conclusion we have to consider yet another peculiarity of non-differentiating homophony. When a number of mnemic sensations are felt which, while not identical, yet differ so insignificantly among themselves as not to allow of a differentiating homophony, the process results in a blurring of non-perceived differences.

The binocular congruence of the two stamps shown on this page illustrates the action of two original sensa-

tions where no differentiating homophony is involved. The congruence of the sensations felt in the right and left eye, respectively, cannot be accomplished either by crossing the visual axes or (what in a prolonged attempt would be easier) by using a stereoscope or haploscope. We can verify whether complete congruence, or overlapping, has taken place by noticing whether both the central portion of the stamp as well as its framing of black dots on white appear as single and quiescent, whereas the outlying parts of the stamp, but which are still inside that frame,

appear in a state of unrest. What that apparent unrest is caused by we are now going to examine.

What happens is that the overlapped sensations of the centre of the stamp and its frame of black dots are so coincident as to result in a perfectly undisturbed homophony. The sensation thus obtained forms an image which could at any moment be reproduced in drawing with the utmost precision of details. The case is different with the periphery of the stamp (i.e. inside its black-dotted frame). In many of the fields of sensation there is at least partial, though sporadic, coincidence of the two congruous sensations, while in others such coincidence is lacking, whence arises a peculiar state of things best understood if one tries to draw the whole image of the stamp. Even with the periphery of the stamp, and in places where two sensations meeting in the same field are different, there are moments when a single sensation only emerges clearly and quietly. This happens whenever, of two conflicting sensations, one gains the upper hand for a time. But if we take other parts and seek to reproduce them by drawing, we shall always find some in which never for one moment is there repose or distinctness. Before one can be seen it is expelled by the other or there arises for an instant a mixed image, for instance, in one corner a No. 3 blurred by a whitish transparent quadrilateral figure.

Such is the condition of things when there is homophonous congruence of only two figures with so much in common that one does not entirely obliterate the other but which in places yet differ so much that at these points a lively and long-drawn competition between them arises. The consequence of such competition in the example given, and generally in cases where there is homophony of two such sensations only, is more a condition of unrest and, at most, of a certain indecisiveness than of actual blotting-out. It is, of course, otherwise when homophony and competition arise no longer between two only, but between dozens and even hundreds of sensations in identical fields, as happens in the numerous cases we have already alluded to of non-differentiating mnemic

homophony. Then the crowd of warring sensation-components in the same fields, of course, brings about not unrest but positive obliteration.

But there is yet another factor. In my experimental example I have chosen an image which is similar in colour for the right and left eye. Had I taken instead for the left eye a stamp of which the contours were red and for the right eye one of which the contours were green, both stamps being otherwise alike (thus following the experimental method adopted by Schenk [1] when investigating binocular mixture of colours), then, on looking at the periphery of the respective images, we should have felt the same unrest and indecisiveness as in the example on page 274, while in the inner portion, where there reigned no competition but only perfect homophony, we should have seen the green and red fused in a dark grey. For under similar conditions homophony results in a mixture, that is a neutralization, of colours.

Let us now illustrate by some examples the consequences which ensue from the above in cases of homophony where the components are, however, not numerous. Suppose I have long possessed a house which I have looked at from a particular point on innumerable occasions at various times and seasons, sometimes seeing it with snow on its roof, sometimes with its trees green or yellowing or bare, with the sun shining or the sky grey, or in fog, rain, snow-blizzards, or in moonlight or lamplight. When I wish to ecphorize the image of this house I can do so by fixing my attention on a definite, temporally determined engram of the same, for instance, when I first saw it or such as I showed it later to a friend, or finally as I turned to look back at it when leaving it for ever. On each of these occasions I obtain a concrete image, accurately determined and sharply circumscribed, corresponding to a single mnemic sensation-complex which is focussed by my attention and banishes all other homophonous elements into the background, or perhaps overpowers their ecphory

[1] F. Schenk, *Einiges über binokulare Farbenmischung*, Marburg, 1901.

altogether. But if no such exclusive simultaneous complex is brought into play, but all the engrams belonging to my view of the house are allowed to act homophonously, then I obtain an image in which various concrete details of the original are vague or blotted out, an image with no special illumination and with many details vague—in short, an abstract image of the house. This example may not come home to persons, such as certainly exist, whose mode of thinking is so inveterately concrete that when closely contemplating some homophonous mnemic sensation (especially in the visual field) they fix upon one representative only in any particular simultaneous complex. For such persons our experiment would naturally prove abortive.

But in the auditory field the experiment would be more generally successful. Almost everyone, I think, can reproduce in memory such a familiar air as the Lorelei Song (*Ich weiss nicht was soll es bedenten*), as heard either as a solo or in parts, played on the piano or blared out in the open air by a brass band. Anyone may also recall the air in an abstract form, that is, as a tune in itself, neither sung nor played, nor blared, and this without being able (as only few persons are) to read it off with the mind's eye from a visual mnemic image of the written or printed notes. Compare with this the case of a melody heard once or a few times only, say an operatic air beautifully sung, or a slow waltz tootled by rustics, and you will find how hard it is to free such a tone-sequence mnemically from the characteristic peculiarities of its simultaneous complex, that is to say, hear it with the inner ear in the same abstract manner as a more familiar melody. It requires much greater musical practice to achieve such an abstraction without the aid of homophony.

Processes of the kind which result in abstract mnemic images, without any conscious effort at abstraction, are for the most part due to mnemic homphony. When we speak of a dog as distinguished from a wolf, we immediately have an abstract image of the dog which is a product of the homophony of thousands of separate engrams.

Personally I know that I do not mnemically reproduce one concrete dog nor even one particular kind of dog, such as a St. Bernard, a Dachshund or a retriever or setter, but just a vague, homophonous creature of middling size and general canine features, but not with the marks of any particular breed. And it is the same when I speak of humans in contradistinction to manlike apes. Each of these in images is, so to speak, generalized. I illustrated this in *Mneme* by reference to those American photographs which reproduce the general features of a type by combining on one plate a great number of overlapping heads. This illustration is striking, and misleading only in so far as these photographs give us something fixed and stable, while the generalizing action of homophony yields the continual interchange of a living process, of which the simplest prototype is rather the homophonous congruence of slightly different stamps (see pp. 274–6).

Here we have no such overlapping of images, but a cognate concrete case of remarkable simplicity, which is also very instructive in so far that the neutralizing of the difference between the two sensations takes place partly through a kind of equalization due to homophony (viz. the grey colour resulting from green and red, p. 276), partly through the uncertainty of the victory between competing diversities (contours of the periphery, p. 274).

Undoubtedly both processes play a part in forming abstract memorized images through the action of homophony. Obviously, equalization, and especially obliteration, of differences in a mnemic homophony of many components must be made much more complex than in the example of the stamps, which deals with only two components.

Already in *Mneme*[1] I pointed out that the appearance of such abstract *images* is a first step in the construction of abstract *ideas*. I have given the name of " physiological abstraction " to the rise of such abstract optical, acoustic, and so on, images through the action of mnemic homophony, and such abstraction is the forerunner of conceptual or

[1] S. 219.

logical abstractions. I wish, however, and for various reasons, to alter this wording into "*abstraction through homophony.*" This faculty of abstraction is not confined to civilized (or thinking) men but is found in every Australian "black," in every Weddah, who has not yet grasped abstract concepts; nay, it is not even the exclusive possession of the human family, but shared in many respects by all the higher animals.

The notion that representation takes on a general, generic character through the fact of separate concrete images in memory presenting themselves *en masse* to the mind, was first expressed by Hume; and Huxley, in his admirable monograph on Hume,[1] developed ideas which, referring the initial faculty of abstraction to the coalescence in memory of various concrete images, approximated still more to my explanations of the simplest from of abstraction. Huxley[2] even made the comparison with types acquired through the overlapping on one photographic plate of different heads. I would give prominence to this fact and insist on the priority in this respect of Huxley and, in a less degree, of Hume. With far less definiteness, W. Roux, in his well-known work,[3] also makes a remark which remotely recalls those of the two above-named pioneers. Roux evidently had no acquaintance with Huxley's book, which appeared two years before his own; and while he, not being a specialist, abandoned all further examination of the psychological question, Huxley had proceeded to a relatively clear statement of the problem, although even he missed a complete solution through lack of the concept of homophony.

I myself was unaware of Huxley's previous contribution to the above way of thinking at the time that my own aim first became clear to me, the aim, namely, of setting up the concept of homophony and its extension from the region of mnemic to that of original sensations and excita-

[1] Th. Huxley, *Hume*, London, 1879 (last edition), London, Macmillan & Co., 1902, pp. 92–4.

[2] *Ibid.*, p. 95.

[3] *Der Kampf der Teile im Organismus*, Leipzig, 1881, p. 234.

tions, and of studying its combinations and the various phenomenal forms which these assume, forms among which abstraction through homophony is only a special case. Only thus was a firm foundation, in my view, established for this primordial form of abstraction and the path opened for investigating it experimentally, as shown by the example of the stamps.

SEVENTEENTH CHAPTER

THE DIFFERENTIAL OF SENSATION AS MANIFESTING DIFFERENTIATING HOMOPHONY. THE TWO MODALITIES OF COMPARISON —THE ENGRAPHIC ACTION OF HOMOPHONOUS COMPONENTS

WE have distinguished between two different manifestations by sensations of homophony, describing them respectively as non-differentiating and differentiating. Briefly, non-differentiating homophony exists when the differences between the homophonous components of excitation (differences which within a certain range are always present) have in their energetic action and counteraction so little clinching power that no manifestation in sensation results from their antagonism. Differentiating homophony, on the other hand, comes to the fore when there is a sensation of difference or one sensation expresses itself in some peculiar kind of translation. The expression in sensation of a difference among homophonous components, whatever its nature, I describe as a *differential of sensation.*

The process of differentiation, so far as I see, consists invariably in the opposition of two components, and the *differential of sensation is the expression by sensation of the antagonistic action of the respective difference between these two, otherwise homophonous, groups of components.*

A synchronous distinction and differentiation of three or more groups of components in one process of homophony apparently never occurs, and would, indeed, be beyond the capacity of the human organism. On the other hand, two components or groups of components easily

distinguishable may yet occasionally result in some non-differentiating homophony.

Let me give an example:

I see once, for the first time, in the Museum of Leipzig, Böcklin's picture of "The Island of the Dead." I compare that rendering with another of the same subject from the same painter's hand which I had seen—perhaps twelve times—in a private collection in Berlin. I become aware, at the first glance, of a number of variants, and these result immediately in the following differentiating homophony:

$$H\left(\begin{matrix} & & & & A^{13}(or) & & \\ A^1\,(mn) & A^2\,(mn) & . & . & . & . & A^{12}\,(mn) \end{matrix}\right)$$

Suppose I remain some time in Leipzig and see the picture there again some half-dozen times; then, later, on recalling both images to memory in conversation, there will arise the following differentiating homophony:

$$H\left(\begin{matrix} A^1\,(mn) & . & . & . & . & . & . & . & . & A^{12}\,(mn) \\ A^{13}\,(mn) & . & . & . & . & . & . & . & . & A^{18}\,(mn) \end{matrix}\right)$$

But at other times, when I do not collate the two groups of components and only recall the generalized image of Böcklin's sketch, the elements will group themselves into a non-differentiating homophony:

$$H\,(A^1\,(mn)\ A^2\,(mn)\ .\ .\ .\ .\ .\ .\ A^{18}\,(mn))$$

Whether in a series of homophonous components—

$$H\,(A^1\,(mn)\ .\ .\ .\ .\ .\ .\ .\ .\ .\ A^{18}\,(mn))$$

a differentiation shall or shall not arise, and in what manner the components of each group shall be combined, depends not only upon differences in the nature of the components, but also and in great measure upon the whole group at the moment when homophony sets in. But when differentiation does arise, as we have seen, two groups are always formed and never more, and a corresponding differentiation takes place.

We have already recognized the following differential of sensation when between the original sensations there

arises a differentiating homophony, e.g. in the optical field :

(1) Sensation of Depth (p. 127).
(2) Sensation of Dazzlement (p. 133).

In the acoustic field :

(3) The sensation of the direction of sound (p. 125).

To these differentials in the case of homophony of original sensations there are attached also two wider classes which result from the differentiating homophony of two sensations or groups of sensations, one of which may be original and the other mnemic, or else both mnemic. Such differentials of sensation are :

(4) Simple recognition of a previous sensation.
(5) Recognition with a sense of difference.

The last-named kind of sensation is in many respects the most evident and intelligible expression of a differential of sensation. For here the result of differentiation is felt immediately *as* a difference and not, so to speak, as something to be translated into a symbol. But since, wherever there is congruity between original and mnemic components in homophony, an immediate recognition of the sensation is linked therewith, I think it best to consider first the pure form, as being that which can arise alone and is, consequently, less fundamentally complicated.

The sense of recognition is oftenest the manifestation of differentiating homophony between an original and a mnemic sensation; but, on rarer occasions, also between two mnemic sensations or two mnemic homophonous groups of sensation. Let us begin with an example of the first and more frequent case. Walking about a neighbourhood where I have never been before, I see a house which awakens the distinct sensation : " This is known to me. I have seen this house before." But despite all my efforts I cannot succeed in remembering where and when I received the previous impression. The surroundings of the house are to me entirely unknown and strange, and no reflection

affords any clue through association. Finally, I learn on inquiry that it is the residence of a celebrated sculptor H., and I then instantly remember that, years previously, I had seen a photograph of the house in an Art Journal: that is, I saw just its picture without any accompanying associations. Here then, if we describe the sensation-complex of the photograph as A, we get the homophony $H\begin{pmatrix} A^2\,(or) \\ A^1\,(mn) \end{pmatrix}$. The expression in sensation of the *differentiation* in this homophony, that is, the differential of sensation, has reference here exclusively to the temporal element (or order in time); it affirms: "This picture of the house seems to me to be not only an actual original sensation-complex, but also a mnemic one, belonging to an older engram-layer."

The separation between these two homophonous components goes no farther. Their expression in sensation is unified, and the fact that they are in a certain sense separate is analogous to the separate excitations between right and left in stereoscopic sight, or between right and left again in the double hearing of sound direction—only here this fact falls under the rubric of sensation of recognition.

It may perhaps be objected that the mere sensation of recognition does not always necessarily carry within itself a *clear* element of time expressible as "now as well as before." But even less clearly is this element of time-relation always contained in the sensation of the thing recognized, and the more attentive one is to a sensation of recognition, the more is one conscious that the expression "now as well as before" is appropriate to it and characterizes the sensation of recognition as a differential belonging to temporal localization in the engram-hoard.

For the rest, a differential of sensation necessarily shows itself to be the product of differentiating homophony only through the mode of its origin, but not necessarily through the immediate contents in consciousness. For instance, the differential in the sensation of depth contained in binocular sight is recognizable by the mode of its origin and not by its contents in consciousness; and the same is

true of di-otic hearing in sound-direction. But, on the other hand, in the sensation of recognition the contents of consciousness as such immediately reveal the character of a sensation as differential, and therefore confirm the result at which we arrived through an analysis of the phenomenon's uprise.

It almost always happens that recognition takes place exclusively, when we have the double sensation of an original (felt as such) and a remembered impression; and Höffding describes such recognition as " a middle position between sensation and representation," that is, between an original and a mnemic sensation.[1] But a sense of recognition can similarly arise in case of differentiating homophony between two sensations which are both of them mnemic. It has happened to each of us to see some person whose face did not at first awaken any sense of recognition, but about whom later, perhaps even after some hours, the mere recollection of that apparently unknown person is suddenly accompanied by the sense of having seen his face before, perhaps, however, without immediately distinguishing to what engram-layer it appertains; in short, without the sense of recognition being accompanied by its appropriate associations. In such a case the sense of recognition arises as a consequence of differentiating homophony $H\begin{pmatrix} A^2(mn) \\ A^1(mn) \end{pmatrix}$.

It was impossible to attain our conception of recognition as a differential of sensation without previously setting up and thoroughly analysing the concept of homophony. Without this preliminary no complete understanding of the question is possible, and one remains half-way, as happened with Höffding, although it was through him that the examination of this problem was initiated. He drew attention to the position between immediate sensation and representation of the recognition process, and even said[2] that " in recognition there is an element

[1] H. Höffding, *Psychologie in Umrissen*, 3 deutsche Aufl., Leipzig, 1901, S. 168.

[2] *Ibid.*, p. 168.

of representation as well as of sensation," but he not only conceives these two elements in their sphere of manifestation as completely coalescent (an idea to be contested or, rather absolutely rejected), but he extends this notion of coalescence to the excitations which sensations reveal. His way of thinking is as follows: A first impression causes the molecules to be circumscribed. This disposition has an innate tendency to repeat itself when the same impression is repeated.[1]

This conception is utterly opposed to that from which I derive my idea of homophony, and one cannot understand how Höffding can reconcile it with his written formula $\binom{a}{A}$. According to his explanation as quoted above, recognition includes the original element of sensation A, but not the mnemic (representation) element *a*, instead of which we get the "greater ease" with which A repeats itself in consequence of a previous rearrangement of molecules.

This essential contradiction in Höffding's exposition, together with his failure to explain exhaustively the association by likeness (see my tenth chapter), has prevented full justice being done to the soundness of his central position. As often happens, the good side of his conclusions has been lost sight of in contending against its weak points.

In this Höffding's chief opponent is A. Lehmann,[2] who attacks him chiefly on the score that he goes back to association by likeness to explain recognition, whereas Lehmann makes this depend upon association by contiguity. I have already demonstrated in the tenth chapter of this work that such a controversy becomes meaningless as soon as we discriminate adequately

[1] H. Hoffding, "Über Wiedererkennen, Assoziation und psychische Aktivität," *Vierteljahrzeitschr. f. Wissenschaftl. Psychologie*, Bd. 13, 1889, p. 433. See further the continuation of this subject in Bd. 14, 1880; also H. Hoffding, "Zur Theorie des Wiedererkennens,' *Philosophische Studien*, Bd. 8, 1893.

[2] A. Lehmann, "Über Wiedererkennen," *Phil. Studien*, 5 Bd. 1889; "Kritische und experimentelle Studien über Wiedererkennen," *Phil. Studien*, 7 Bd., 1892.

between the two conceptions of ecphory and association. Lehmann conceives much more clearly than Höffding that "in certain cases" recognition results from comparison. But by introducing the question of association through contiguity the whole controversy becomes unnecessarily complicated and frequently diverted from its proper course—a diversion which is avoided as soon as the idea of ecphory is duly separated from association, or, in a word, when the question is based upon our double mnemic principle. Even Lehmann, while right in assuming that recognition is an effect of comparison, failed in thoroughly grasping the meaning of homophony. It follows that to steer one's way between what is correct and what erroneous in his view is more difficult than with his opponent Höffding; and that when his notion is critically discussed, as, for instance, by Claparède [1] or by Calkins and Gamble,[2] usually only a part of it, and not the best part, is brought out. For the rest, we have to thank the last-named investigators for the valuable experimental demonstration that the essential elements in a process of recognition are not the accompanying associations to which Lehmann attributed so great importance.

The question whether it is more correct to describe recognition as sensation or feeling, a point similarly discussed, has for us little interest. It seems to me certain that recognition does not consist merely in a rather pleasurable complex of organic sensations, a complex to be described as a mode of tension or appeasement. How often does it not happen, when our eyes are wandering indifferently and without any expectation over a strange environment, that something strikes us suddenly as already experienced. Now in this case, if the above theory were true, we should feel relief without any previous tension, which is clearly not so.

Expectation enters into recognition only when we try

[1] E. Claparède, *L'Association des Idées*, Paris, 1903, p. 336.

[2] A. McC. Gamble and M. W. Calkins, "Die reproduzierte Vorstellung beim Wiedererkennen u. beim Vergleichen," *Zeitsch. f. Psychologie d. Sinnesorgane*, Bd. 32, 1903.

to localize more exactly in our engram-store something recognized as previously known, and pleasurable relief ensues when our effort is followed by success.

Such a feeling of pleasurable relief is accompanied by every ecphory which implicates a fixing of attention, and is specially characteristic of such an ecphory ; so that the attempt at localization of such a recognized sensation is only a special case of the kind of ecphory in question.

Our aim does not require either a closer analysis of the contents of the sensation of recognition or the classification of this process of consciousness, since it is interesting to us only as the manifestation of differentiating homophony and in its capacity of a differential of sensation. Its appearance under abnormal circumstances, that is to say, when the conditions for its normal rise exist only partially or not at all (illusion or deceptive memory), will be considered in our *Pathology of Mneme.*

So far, we have been dealing only with recognition when an original sensation is accompanied in its rise by a sensation of recognition. In this latter sensation we have already seen a differential, the product of separation between two homophonous co-operating groups of sensation, one original and the other mnemic, or both mnemic.

Let us now turn to a second kind of differential of sensation, that resulting from the differentiating homophony of two sensations or groups of sensation, one original, the other mnemic, or both mnemic, the differential in question being *recognition accompanied by the sensation of difference.* As already remarked, this kind of sensation-differential is, as regards its contents, the simplest and most direct of any, just because it is the expression of a distinction which is felt as such. The discriminating sensation is the manifestation of an antagonism between two dissimilar components, to be referred in this particular case to a definite incongruity in homophony, or, strictly speaking, to competition rather than to homophony.

In *Mneme* I have given the following description of the peculiar manifestation of this interaction between partly

congruous and partly incongruous components[1]: "If after some years we visit a well-loved and familiar scene, we are keenly sensitive even to the slight changes that in the meantime may have taken place. We note the disappearance of this or that tree, the presence of a new house, or the alteration of an old one. A capable conductor, who knows well the work in hand, and so is able to dispense with the score, notices with astonishing minuteness the omission of this or the premature entry of that part or any slight variant that may be introduced by the soloist. The incongruousness of the mnemic with the simultaneously occurring original process is immediately perceived."

In the same work,[2] in further reference to this phenomenon, I added: "Our whole capacity to differentiate rests entirely on this process." Starting from this, as I now see, incorrect remark, I should like to penetrate further into the nature of this form of sensation-differential which arises in homophony when there is great incongruity between mnemic components and their respective originals.

The activity of our "differentiating capacity" is by no means confined to the rise of a homophonous group; it displays itself already in the fact of the side-by-sideness of sensations. Every sensation of a multiplicity entails such differentiation. When I say that I hear a third or a fourth in music, that only means that I distinguish three or four tones. Of course, in mere side-by-sideness without homophony, what I feel is the possibility of a sensation of difference as distinguishable from the full sensation of identity. Similarly, I can see the simultaneous presence of the same redness in different points of my visual field, but these rednesses are separated by localization in different regions of sensation, and the same is true for synchronous tactile sensations. In side-by-sideness there can never be a full equality of sensations; what happens is that an original sensation enters into homophonous contrast with

[1] *Vide* translation of *Die Mneme*, by Louis Simon, p. 153 — TRANSLATOR'S NOTE.

[2] *Ibid.*, 2 Aufl., S. 202.

a former original and now mnemic (that is, acoluthic *plus* mnemic) sensation; what takes place is *homophonous comparison.*

From this follows that the reaction between likeness and unlikeness in case of homophony of a synchronous original and a mnemic (acoluthic *plus* mnemic) sensation constitutes the most perfect form of comparison. Of course, we can also compare two synchronous original complexes of sensation in their *side-by-sideness.* I can say at a glance: "These two books lying *side-by-side* in the middle of my visual field are of about equal size," or else, "one is bigger than the other." Self-observation, however, reveals that in making an accurate comparison one sets to work in another manner. When the comparison is an optical one, we look at the objects as closely together as possible, fixing one first, and, a good impression of that obtained, we glance so rapidly at the other that the corresponding areas of the acoluthic-mnemic and the original image overlap.

A principal reason why this method is usually adopted as more advantageous is that it allows of measurement with nearly the same instruments, that is to say, that the comparison of synchronous original and acoluthic-mnemic sensations activates for their production nearly the same points in the retina. Moreover, this method has a further advantage over the comparison of synchronous original sensations in *side-by-sideness* in the visual field. In differentiating homophony, every excitation-complex of the original complex (*a*) manifests itself, together with the corresponding mnemic (acoluthic *plus* mnemic) component (*a*) which is being compared with it, whenever there is congruous homophony through the presence of one constant sensation-component, itself the product of homophony. This is not the case when the components of the complexes are incongruous. Among these there is always competition, and consequently comparison between two discrete objects brings out likeness and unlikeness far more strikingly than where the comparison deals with "side-by-sideness," in which side-by-sideness even the

most similar elements in the compared complexes have each a separate, independent representation in separate fields of sensation. A clearer understanding of the superiority of the one method over the other can be reached through the following analogy. We want to compare as accurately as possible two curves which, while resembling one another, are not quite identical. We can do this by drawing them side by side as near to each other as possible without intersection, so that their corresponding sections are as nearly as may be parallel. But we obtain a much more perfect representation of their likeness and unlikeness when drawing one curve on tissue paper and laying it in corresponding position on the other. Then the really similar sections fall into one line, and the different ones stand out against it as a second line. Here we have employed a method analogous in one respect to the result of a differentiating homophony.

The superiority of this latter mode of comparison over the comparison of two original sensations in a *side-by-sideness during their synchronous phase* is now fully comprehensible. It rests essentially on the homophonous identification of likenesses contrasted with unlikenesses.

The general conclusion to be drawn from all this is that comparison through simultaneous stimulation is inferior to comparison through successive stimulation. Most writers, for the rest, speak of the first case as simultaneous comparison and of the second as successive comparison. But these expressions, which I shall now examine, can give rise to misunderstandings.

It is true that in the first case the stimulation is simultaneous, and in the second successive, but the comparison always ensues simultaneously. In the first case it ensues between two original sensations which are *both* in their synchronous phase; in the second, it takes place between a synchronous original sensation and a mnemic (acoluthic *plus* mnemic) one of which the synchronous phase is already over. For completeness' sake I had better also mention the rarer case in which comparison ensues between two sensations, *both* of which have passed out of

their synchronous phase. And, *essentially, comparison is always simultaneous.* But where there is successive stimulation the synchronous phase of at least one of the compared sensations—the phase in which excitation and, with it, sensation are immediately dependent on a synchronous original stimulation—*that* phase is already over. To avoid using an unnecessarily difficult vocabulary, I will describe the synchronous phase of a sensation (and excitation), the phase in which it synchronises with its original stimulation, as its *symphase.* When stimulation ceases sensation passes into its *acoluthic* phase, and while this is dying down, or when it has died down, the engram remaining behind can give rise to a new mnemic phase, or, as we should say, can ecphorize it. Both the acoluthic and the mnemic phase can be contrasted on the one side with the synchronous phase, because, in spite of their differences in other respects, they are both after-phases, i.e. they follow temporally on an original stimulation.

From this point of view I call both of them *metaphases.*

We can now proceed to classify comparisons of sensation as follows :

(1) Comparison of two sensations which are both in the condition of symphasis ; or comparison of two symphases.

(2) Comparison of the symphase of one sensation with the metaphase of another ; or comparison of symphasis with metaphase. The metaphase can be an acoluthic or a mnemic phase ; under certain circumstances it can be a mixture of both.

(3) Comparison of two metaphasic conditions ; or *comparison of two metaphases.* We shall not further investigate this form of comparison, as for the purpose in hand it contains no essentially novel point of view, although as regards the higher psychical life, it is by no means unimportant.

It was found by Wolfe,[1] in his experiments on our judgment of simple, consecutive tones, that with an

[1] H. K. Wolfe, "Untersuchungen über das Tongedächtniss," Wundt's *Philosoph. Studien,* 3 Bd., 1886.

interval of two seconds, or, under some circumstances, of seven minutes, precision in comparison decreased in proportion as the interval was prolonged. I would not describe this as "forgetting" and see in it the effect of a functional decline in the engrams, which, in my opinion, requires much longer lapses of time; rather I would attribute the effect, observed by Wolfe, principally to the dying down of the acoluthic phase; and this all the more as Wolfe himself remarks on a certain periodicity (rise and fall) [1] which to some extent recalls the periodic oscillations of optical sensations as they die down (see above, p. 139). To explain these oscillations Wolfe suggests that they are perhaps to be attributed to the intervention of acoustic "after-images." Lehmann,[2] who has made similar investigations in different regions of sense, has a firmer grasp of the subject than Wolfe, and assigns the relative distinctness of sensation in metaphase (if comparison takes place not later than within one minute after the cessation of the original sensation) to the joint action of the "central" after-image and the memorized image. In this way he correctly explains the rapid fading of sensation in the metaphase during the first minute after the original stimulation has ceased. And in my opinion this view is also confirmed by the oscillations which Wolfe had remarked in the distinctness of sensation of the metaphase, especially during the first thirty seconds. This being the case, quite other laws must be sought for the effect of time upon the decline of functional capacity in engrams.

It is easy to understand the presence of an acoluthic sensation in the first minute after an original stimulation and its synchronous sensation have ceased; but it is not quite so easy to account for the simultaneous presence of the corresponding mnemic sensation. Indeed, under ordinary circumstances this sensation is not present. But the second stimulation, applied for the purpose of

[1] H. K. Wolfe, *ibid.*, pp. 20, 23, 24.

[2] A. Lehmann, "Über Wiedererkennen," Wundt's *Philosoph. Studien*, 5 Bd., 1889; cf. particularly S. 127–8.

comparison, causes the ecphory of the engram left by the already ended synchronous phase of excitation; and under these circumstances the sensation of the metaphase arises out of a combination of *acoluthic* and mnemic sensation. This point once made clear, I hope there may be no misunderstanding if I usually describe sensation in its metaphase simply as *mnemic*, reserving the cumbrous formula " = acoluthic " or " = acoluthic *plus* mnemic " for the possible case of an observation made in the first minute after an original stimulation has ceased.

The fact of a comparison between *symphase* and *metaphase* being far superior to one between two symphases has long been known. Already in 1846, E. H. Weber [1] wrote on this subject: " Two simultaneous tactile sensations cannot be so easily compared as two consecutive ones. A series of experiments has shown that two weights are best compared when laid successively on the same part of our hand, then removed and the second weight laid upon the other hand. The least advantageous proceeding is to try both weights simultaneously and one in each hand. Then one sensation disturbs the other through this mixing, just as the relative distance in the scale of two simultaneous tones cannot be so well distinguished as the relative position of tones which follow one upon the other." Weber also brings forward the example of two smells passing one through one nostril and the other through the other, and hardly to be distinguished and generally quite fused; a fact which, as we saw above (p. 84), Zwaardemaker proved with better experimental means, and which has been completed by the interesting observation, that such synchronous original olfactory sensations often neutralize one another until both are abolished. As regards comparison of weights, Fechner's [2] experiments brought him to quite the same conclusions as Weber. Perhaps, however, the superiority of a comparison

[1] E. H. Weber, " Tastsinn und Gemeingefühl," Wagner's *Handwörterbuch der Physiologie*, III, 2, S. 544, Braunschweig, 1846.

[2] G. Th. Fechner, *Elemente der Psychologie*, 3 Aufl., Leipzig, 1907, 1 Teil, S. 88–94.

between symphase and metaphase over that between two symphases is best shown in the localization of cutaneous sensations. For whereas successive stimulation of two contiguous spots of the skin still allows us to perceive that a different spot to the first is being excited the second time, experiment shows that when the distance between the stimulated spots corresponds with that between two "pressure points" in the skin, the distance has to be greatly increased (in some parts of the bodily surface as much as a hundredfold) before we become aware that a simultaneous stimulation is being applied to more than one spot; indeed, there are portions of the body where the two points of simultaneous stimulation are distinguishable only when 50 millimetres or more apart. It was already known to E. H. Weber,[1] and later better established, especially by Stumpf,[2] that we distinguish small differences in pitch when notes are struck successively and not simultaneously. And this happens also when the tones are of equal strength and have no vibration.

We have seen above that the same is true in optical comparison. Only when colours or brightnesses are to be compared through immediate contiguous *contrast* do things take place differently, and this particular exception is easy to understand. Also, when an immediate contrast is not obtainable, for instance where two patches of colour cannot be brought into direct contact, then it is much more advantageous to look first at one patch and then at the other than to compare them simultaneously but separated by a third colour in the side-by-sideness of the visual field.

This examination should convince us of the superiority of a comparison between a symphase and a metaphase over that between two symphases. Even if we are *not* confident of having understood all the principles of this particular phenomenon, a beginning of comprehension is

[1] Cf. E. H. Weber, *Annotationes anatomicæ et physiologicæ*, 1834 (1829); again, M. v. Frey, *Das Sinnesgebiet der Haut. Vorlesungen über Physiologie*, 1904.

[2] C. Stumpf, *Tonpsychologie*. Cf. the section on judging consecutive tones in 1st vol., 1883, and especially on judging simultaneous tones in 2nd vol., 1890.

sure to result from our understanding of some of the conditions of the two distinct phases.

It would indeed be strange if we were able to estimate more accurately the intensity (in a narrow sense) of two sensations by comparing a symphase with a metaphase rather than two symphases together, if we took our stand upon the usual point of view that the intensity of the synchronous original sensation far surpasses that of the mnemic one. But we have seen (p. 228) that such is not the case. A mnemic fortissimo, however shadowy our ecphory of the original mass of sound, is still a fortissimo, and has not the slightest resemblance to an original pianissimo. For, as we have already explained, it is not the *intensity* but the vividness of the mnemic metaphase which is so much less than in a symphase. This point is further established by the following considerations. *How could we possibly arrive at an accurate estimate of intensities by comparing synchronous original with mnemic sensations, unless the intensity of sensations in their metaphase, even if not itself constant, did not at least contain some element which is constant?*

That, on the other hand, the vividness of a sensation is usually infinitely less in the metaphase than in the symphase is a point already fully explained (pp. 214–224).

If we compare two sensation-complexes in their symphase, they will undoubtedly, but *cæteris paribus*, appear approximately equal in vividness, but they are in every respect rigidly determined by the stimulation producing them, and in so far they are both, so to say, stiff and incapable of accommodation. At the most, when attention is directed to one part of a complex and disregards the other, is a certain very slight accommodation possible. The exact opposite is the case when a symphase is compared with a metaphase. In the metaphase sensation, especially mnemic sensation beyond the acoluthic phase, is infinitely less vivid than the synchronous original sensation, so much so as to permit of no comparison between the two. As regards all other values, however, we must regard it as a true repetition of the synchronous original sensation,

which is sufficient to prove our present fundamental contention, viz. the superior results obtainable by comparing symphase with metaphase.

Whether the great difference in vividness between a synchronous original and a mnemic sensation facilitates or not a comparison is a question we shall leave to the end. At present we must mention some evident advantages offered by the homophonous comparison of symphase with metaphase as opposed to the non-homophonous comparison of two symphases.

Whenever we wish to test two sensation-complexes in their mutual likenesses and unlikenesses, we begin by bringing them as much as possible under the same conditions. For instance, we place images of space so that their axes may be parallel ; and when possible reduce their respective sizes to the same measure.

. So a zoologist, when placing the drawings of a crocodile's and a squirrel's brain for comparison, likes to reduce both to the same proportions by making one smaller and the other bigger.

Similarly, when comparing two simultaneous optical objects, we try to get both in the same light ; or where the comparison is between different sensations of tone we try to obtain the same strength for both, and so on. And where synchronous original sensations are to be compared, these conditions are absolutely indispensable. For instance, it is quite impossible to compare in the same field the different heraldic eagles of two coins, such as the mark of 1875 and that of 1899, when so placed that their respective median lines make a blunt angle with one another.[1] Again it is extremely difficult to distinguish between two notes of only slightly different pitch, when simultaneously produced, or, if such a distinction be made, it is difficult to say which is the higher and which the lower, if one is struck hard and the other gently. The comparison between symphase and metaphase is very much easier, because

[1] For the conditions for comparison and recognition of shapes, see Mach, *Analyse d. Empfindungen*, 4 Aufl., 1903, S. 87–9.

we have no difficulty in shifting or turning a mnemic optical sensation in the field of vision during its metaphase, nor any difficulty in increasing the *intensity* of a mnemic acoustic sensation in such a way that it can be easily compared with a more (or less) intense original sensation, and to do this without in the least altering the pitch of the sensation which is in metaphase.

The circumstance that, in homophonous comparison of symphase with metaphase, one of the objects being compared, namely the mnemic sensation, is to a high degree movable and, so to speak, *displaceable*, renders this mode of comparison much more advantageous than that between two symphases, because during symphase the continuation of the original stimulation keeps its relative synchronous sensation (so to speak) fixed, so that we cannot adjust the objects of comparison to one another by reducing them to common proportions.

To this we must add the superiority already mentioned (pp. 290–91) of homophonous over non-homophonous comparison—a superiority due to that congruence of components which causes them to be felt as unified, with the result that incongruous elements are thus more acutely distinguished. But there probably remain other reasons for the obvious superiority of a homophonous comparison of symphase with metaphase over that between two symphases arising in *side-by-sideness*.[1]

[1] The differentiating homophonies of two synchronous sensations, as in binocular sight (perception of depth) and di-otic hearing (sensation of direction of sound), are peculiar cases, not to be summarily disposed of as being comparisons. If we are to treat them as such, to which there is no objection, then it must be in the sense of a *homophonous* comparison between two symphases, and here again we get, as with binocular sight, the superiority we are claiming for homophonous over non-homophonous comparison. For, as already remarked, in monocular sight a difference of ten seconds of an angle can only be perceived under very favourable circumstances. In homophony of binocular sight, on the contrary, difference in depth of ten seconds can be perceived under nearly any circumstance, and when conditions are favourable the differential of sensation makes discrimination possible within a limit of five seconds.

Now that in the foregoing chapter we have explained the basic phenomena of differentiating homophony so far as self-observation and experimental investigation on other persons can teach us, I would here briefly indicate that the field of action of differentiating homophony is very much wider. In the same way that we can detect in *non*-differentiating homophony the real rudiments of abstraction such as it exists in the lower animals as well as in man (*vide* p. 270), so also we shall find matters to stand as between *differentiating* homophony and recognition along with perception of differences in recognized objects and sensations.

In *Mneme*,[1] I have shown that recognition and discriminatory sensation in the homophony of a synchrono-original and a mnemic sensation-complex can be affirmed in the case of higher animals, not only by analogy with man, by certain reactions, so that what we are dealing with is not any privilege of the human mind, but a wide-spread, in a sense fundamental, process. I will repeat the examples I have there given, but should like the reader to look at them again. In the case of higher animals the motor reactions there described are indubitably accompanied by the corresponding sensations which we have experienced in ourselves, and where they take place we can unhesitatingly speak of recognition and discriminatory sensation as similar to that which we have introspectively observed in our own minds.

In that seventh chapter of *Mneme*,[2] my attempt was directed to demonstrating, through objective perceptual reactions, the presence and efficacy of differentiating homophony; I even brought forward cases in which any manifestation in *superliminal* sensation is lacking. In these last-mentioned cases there must exist a *differential of excitation*, manifested not in a superliminal differential of sensation but in reactions of some other sort, objective

[1] 2 Aufl., S. 205–9. In English translation by Louis Simon, p. 154 ff.—TRANSLATOR'S NOTE.

[2] *Mneme*, English translation, p. 154 ff. In German, *ibid.*, 2 Aufl., S. 212.—TRANSLATOR'S NOTE.

reactions equally indicative of incongruence in homophony. Whether in such cases there are subliminal differentials of sensation is a question apart which we need not here consider, perhaps returning to it later.

However that may be, differentials of excitation resulting from incongruence in the homophony of excitation not only play a part in the instinctive life of animals, represented therein chiefly by motor reactions, but are also fundamental agents in organic regulation, regeneration and kindred processes in which they express themselves through plastic reactions.

Before closing this chapter I may touch upon a question regarding differentiating and non-differentiating homophony: namely, the engraphic action of homophonous excitations and differentials of excitation. I have already (p. 260) drawn attention to the capacity of the stimulable substance to retain, out of every synchronous excitation-complex (whether caused by original or mnemic excitations), a corresponding alteration—a *synchronous engram-complex.* To this statement I added the following remark: "Of course, various excitations are not subject to the engraphic process in the way that they would be if separately produced, but only come under it in their conjunction as members of a synchronous complex, and are consequently modified by the various influences of reinforcement by contrast, weakening to the point of neutralization, fusion, homophony and differentiation."

In accordance with this, when we recall at a given moment the image of a picture seen under various circumstances, and when, consequently, the ecphory of ten engrams, belonging to ten different layers of our engram-store, results in homophony of ten corresponding mnemic excitations, the ten homophonous but not fused excitations do not leave behind in the layer where they have been ecphorized ten new engrams, but one only, of a peculiar constitution, the product, namely, of their energetic resultant, which is manifested in a corresponding unified sensation of reinforced vividness. For this reason the homophony of excitations produces, on the side of mani-

fested sensation, a rise in the degree of *vividness*; and on the engraphic side it produces a stronger, better-defined and more permanent engram, out of which is ecphorized a mnemic excitation of increased vividness but not of increased intensity. That is to say, out of an engram so formed there is ecphorized a mnemic sensation which in the case of weight is not heavier, in the case of greyness not whiter, in the case of a low tone not louder, but all the sensations will be *clearer* when compared with those arising from a weaker engram.

The same is true for the engraphic action of a differential of excitation. The differentiating components have not to be brought into opposition with one another at each new ecphory in order to generate a new differential of excitation which will be manifested in a new differential of sensation. But the energetic resultant of both differentiating components, that is, the differential of excitation, retained as such, *already acts engraphically.* That is, *the case is proved by the circumstance that this differential, when ecphorized, emerges again immediately and quite independently of the new grouping.*

For the rest, this happens not only with the products of homophony, but the energetic resultant of two interacting excitation-components has a necessary engraphic consequence, even when such a resultant shows itself as a strengthening through contrast, a weakening, a neutralization or a fusion. Looked at from the energetic standpoint, this must be obvious. Nevertheless, it will be necessary, now that we have gone so deeply into our analysis, to embark upon a synthetic review by which the whole apparently complicated process of our exposition may be placed in a much simpler light. We have learnt to know the numerous and complicated factors which condition the discharge of many original and mnemic excitations. All these factors in manifold interactions join to form a new but in no sense homogeneous unity. And although this does not result in an identity of the conjoined components, the process brings about a considerable simplification of the complex play of energetic interaction.

EIGHTEENTH CHAPTER

COMPETITION OF ORIGINAL AND MNEMIC SENSATIONS WITHIN THEIR COMMON AREA. ALTERNATIONS

UP to now we have seen how original sensations and excitations set free mnemic ones through the ecphory of engrams; how both sorts of sensations influence each other within the same simultaneous complex; how, for instance, they mix together, strengthen or weaken one another, enter with each other into a homophonous relation and form differentials of sensation. As regards the weakening, we have seen that two original sensations (such as olfactory ones) can so neutralize one another reciprocally that under certain circumstances superliminal manifestation disappears.

We will now consider the cases in which the presence of a particular sensation excludes another, that is, in which a simultaneous assertion of the presence of both sensations is not possible. If the conditions are such that either sensation or excitation, which might otherwise be set free, is prevented from making itself felt, what happens may be described as an *alternative* of sensation and excitation. The decision of the alternative *excludes* one sensation or the other, since both sensations stand to one another in the relation of mutual exclusion.

Such peculiar cases form a group apart, requiring special study, for they are, as we shall see in our brief concluding remarks, of very significant biological importance. On the other hand, this group of mutually exclusive sensations is not entirely isolated from the much greater group of sensations which do not exclude one another. There are transitions of different kinds, and it is well to start our

investigations from the larger group, from those not mutually exclusive sensations which can be synchronously experienced in *side-by-sideness*. We can, however, disregard all the relations of sensation in which two sensations are merged in a third or unite to produce a manifestation of superior vividness to that of their several components (homophony), or, finally, more or less neutralize one another. So we shall here only consider that class of sensation-relations in which the duality of any two sensations is under all circumstances preserved.

The fact that we can feel this duality or, otherwise expressed, this *side-by-sideness* implies that the two sensations so experienced do not mutually exclude one another. Still, we learn by the experiment of fixing our attention first on one and then on another that almost all sensations thus existing side by side are capable of such mutual exclusion. The more we are able to concentrate attention on one of two sensations, the more does the other recede into the background, becoming weaker and weaker in consciousness and sinking at last to such a level that we are no longer justified in reckoning it among the manifestations of sensation belonging to that particular complex of excitations.

We may express this by saying that the process whose manifestation in consciousness is designated as attention has the effect that the vividness of certain components of a simultaneous complex increases while the remaining ones are correspondingly depressed. And, *cæteris paribus*, the greater the increase, the more marked is the depression of the other joint components, the more it approximates to exclusion, and consequently the fewer these competing components become.[1]

[1] Our purpose does not require us to go more closely into the laws governing these processes—luckily, as otherwise we should wander far from our theme and require inordinate space. I would only emphasize the circumstance that to what is called attention correspond peculiar laws, many of which, still uncertain, are connected with the interplay of simultaneous and successive excitations and sensations. But these laws form only one chapter of the code which we are trying to study in the present work.

For instance, a man strenuously attempting to hit a distant target is aware for some moments of practically nothing but a visual sensation in the middle of his optical field. He has no superliminal consciousness of his middle and peripheral field of sight; he hears no sounds in his neighbourhood, not even the shots falling around him; he does not feel the burning sun on his back nor smell the powder of other rifles. But he sees the "sight" of his gun and the central parts of the target far more clearly than would be the case if he had sensations of the rest of the target and of the surrounding landscape, or than if he heard the chatter around him, felt the actual temperature and were aware of the environing odours, etc.

Thus, the more attention extends to various components of the simultaneous sensation-complex, the more it is "divided," the less also becomes the vividness of the items enclosed within its circle. Corresponding to the increased number of sharers is a decrease in the share of vividness accruing to each, the vividness in its general effect being limited at any given moment. Expressing ourselves metaphorically, we might say that the different components of a simultaneous sensation-complex are competing candidates for a portion of the vividness available at the moment. It is characteristic of this joint candidature (to continue the metaphor) that a far-reaching compromise becomes possible. The components of the sensation can expel one another, or they can, each, of course, with relatively lesser vividness, remain side-by-side and be simultaneously experienced. I would formulate these facts as follows:

THE MORE THE VIVIDNESS OF A PARTIAL COMPLEX OF SENSATION INCREASES, THE MORE DOES THE SAID PARTIAL COMPLEX DISPLACE FROM CONSCIOUSNESS THE REMAINING COMPONENTS OF SENSATION WHICH ARE BOUND UP WITH IT, THAT IS TO SAY, THE MORE IT LESSENS THEIR VIVIDNESS. ONE CAN ALSO SAY THAT THE WHOLE PROCESS CONSISTS IN THE COMPETITION OF THE COMPONENTS OF A SIDE-BY-SIDE GROUP FOR A MEASURE OF VIVIDNESS.

The course of our investigations has meanwhile taught

us cases in which it is impossible to find certain differing sensations side-by-side. In these cases the sensations in question would have to appear in the self-same field (see fourth chapter, p. 106), and (contrariwise to the competition just described) there arises therefore an UNCONDITIONAL STRUGGLE FOR A PLACE IN THE AREA OF SENSATION. Up to now, we have explained only cases in which there is a simultaneous appearance of two ORIGINAL SENSATIONS. As already remarked, qualitatively different original sensations in the same sensation-field arise when the sensations in question are produced at corresponding " gates of stimulation."

The best-known example of this is in the region of optics, in the so-called " competition of visual fields " which we have several times touched upon. This phenomenon would be more correctly described not as " competition of the visual fields " but as COMPETITION OF SENSATIONS ON THE RIGHT AND LEFT SIDES OF A VISUAL FIELD. This competition can best be observed when quite different images are offered respectively to each eye and the experiment is arranged so that an image before one eye is unnoticed; which latter happens, for instance, with the open but unoccupied eye in working at a microscope. The simplest experiment for verifying the competition is with a stereoscope, which presents different objects to each eye. This enables us to see that portions of the same binocular visual field are occupied by components answering some to the right eye, others to the left one. Or else these components may appear jumbled up. Or half of the field will be filled with more of one or of the other image. It may happen also that one eye temporarily, almost entirely, annexes the share of the other eye. If the experiment is suitably conducted, what we observe is mostly an irregular but unceasing interchange in these appearances (cf. p. 275).

Such competition in binocular vision is one of the most remarkable cases of alternate sensation. But the occasional circumstance that in the side-by-sideness of a common optical field sensations stimulated separately on

the right and left are yet jumbled together must not lead to the conclusion that the *competing* components are felt as side-by-side. Say we call the sensations on the right

$$a^r \quad b^r \quad c^r \quad d^r$$

and those on the left

$$a^l \quad b^l \quad c^l \quad d^l$$

we may sometimes feel a^r b^l d^r c^l as side-by-side, but never a^r next to a^l nor b^r next b^l, nor c^r next to c^l, and so on. Of course, however, particular experimental arrangements can bring about the coalescence of competing parts through an identity of contours, and thus limit competition to different colours, as in Schenk's experiment with the postage stamps (see p. 276), so that a mixture of competing sensations takes place. We then have one of the exceptional cases already mentioned in which alternatives are not decided but are slurred over by a compromise. It is an interesting fact that in binocular vision the possibility of such a compromise arises only under quite special conditions, viz. when there is identity of contours within coloured surfaces. But there is no possibility of a compromise as regards the contours; they must submit unconditionally to one or other alternative.

We saw in our fourth chapter that there are two other regions of sense in which the release of stimuli through two corresponding "gates of stimulation" makes it possible to bring about the rise of two original sensations in the same field, viz. sensations of hearing and smell.

Two auditory sensations arising through corresponding gates of stimulation (see pp. 104–5 *n*) are, however, always qualitatively equal; between these there cannot be competition but only homophony, and consequently we have not to consider them here. On the other hand, as I have shown, all simultaneous sensations of inhaled scent exist in the same field; consequently there is in this case the possibility of a typical competition. If by inhalation through the right and the left nostril one

obtains two distinct olfactory sensations, there arises, as shown by Valentin, Aronsohn and Zwaardemaker, through a corresponding shading-off of intensity in the two stimuli, just the same competition as in the case of the eye.

Now such a competition takes place not only between original sensations in the right and left eye, or the right and left nostril, but also between an original and a mnemic, or between two (or more) mnemic sensations whenever they are assigned to the same fields of sensation and, moreover, are qualitatively different among themselves. When the latter condition is omitted we have seen that what follows is homophony.

Before going farther into this matter of competition, I would like to complete the explanations regarding fields of sensation which, in the third, fourth and thirteenth chapters, I have partially given. Direct observation of the competing process between sensations arising in the right and left eye immediately discloses the fundamental fact that both eyes together have but one common field of sight (the total of all the fields of visual sensation), in which all the original sensations of sight dwell, function or expel one another.

But respecting this common area of original sensations of binocular sight, or, when I shut an eye, the area of original sight-sensations, which is then monocular, we must inquire, What is its relation to the concept of such fields of sensation as those in which our *mnemic* visual sensations arise and which constitutes the visual field of our inner mental eye? Do mnemic visual sensations join original ones in the same fields, or have they a region of their own? The answer is unconditionally and exclusively in favour of the former supposition.

For we have had to record in many foregoing pages the integration of mnemic with original sensations, when (see p. 167) the original sensations awakened by a mere linear drawing come to be accompanied by mnemic sensations, so that what we perceive is the three-dimensional image of a cube; this can happen only as a result of a field

of sensation common to both these kinds of sensation. And the same, of course, is true of all other regions of sense.

I need only recall the circumstance that the congruence which, as we saw, actually takes place in homophony between original and mnemic sensations is a convincing proof of the presence in the same field of respective original and mnemic components. Nor merely the fact of congruence, but likewise that of incongruence under other circumstances, and the resultant competition all go to prove that original and mnemic sensations occupy common fields.

We will start once more from visual sensations and arrange our experiments so that at one point of our original visual field we obtain the image of an opaque body, and simultaneously at another that of a mnemic equally opaque object. If I concentrate my attention sufficiently on this experiment the phenomenon of competition becomes clearly perceptible. When the mnemic picture gets the upper hand, the original one vanishes, and vice versa. A difficulty in this experiment arises from the slight transparency frequently characteristic of mnemic images—transparency comparable with that of a diaphonous body or a picture on glass, so that the covered portion of the original picture glimmers through the mnemic one. This happens to me when I recall mnemically a familiar painting by projecting it on the background of the bookshelf in my study. The gold lettering of the books shines through the mnemic representation of that painting. But this, again, does not disprove a competition between original and mnemic sensations in a common field of sight. There are compound phenomena of competition observable also in the merely binocular struggle between original sensations in the right and left eye respectively, as, for instance, when, by use of a stereoscope, I bring into competition the picture of a low-toned photographic diapositive with a coloured print quite different in subject. Under certain circumstances the diapositive gets the upper hand in many

points of the field of sight, while in the same places certain of the coloured details become visible (cf. pp. 274–5, for the same effect in binocular competition).

But if in our experiment in competition between the mnemic complex of a picture and the original sensations of a bookshelf it becomes possible to lend sufficient attention, and hence sufficient vividness, to the mnemic complex, then total victory rests with the latter, and it obliterates the corresponding section of the original visual field. I confess, however,[1] that only very rarely does my voluntary effort succeed in bringing about this complete elimination. This is the case because in voluntary experiments the original complex has the unfair advantage of an extra dose of attention, and hence vividness, due to the importance we are attaching to its expected disappearance. If during the experiment one tries to fix the original complex by reading the titles of the books, this original complex immediately gets the upper hand and its mnemic competitor vanishes for ever, or, rather, until it is again ecphorized and attention again strenuously transferred to it.

This kind of competition between original and mnemic sensations of sight, and (when vividness is sufficient) the victory of the mnemic over the original one, is particularly easy to observe in the hallucinations of the insane, and even in those of the normal when under hypnotic or post-hypnotic conditions. For hallucinations are merely mnemic complexes of sensation whose vividness is such that they are mistaken for originals. Forel,[2] who first drew attention to alternate hallucinatory phenomena as supplementing my exposition thereof in *Mneme*, gives the following example: "If one suggests the disappearance of an object, the gap which it really fills is immediately

[1] It would be interesting and fruitful to enlarge these experiments with the many artists who are specially qualified through possessing an unusual power of optical representation and great practice in applying it.

[2] A. Forel, "Eine Konsequenz der Semonschen Lehre der Mneme," *Journ. f. Psych. u. Neurol.*, 5 Bd., 1905, p. 201. Cf. also A. Forel, *Der Hypnotismus*, 5 Aufl., Stuttgart, 1907, pp. 82–6.

occupied by a hallucinatory colour or form. Consequently and vice versa every positive hallucination brings about the disappearance from consciousness of the objects behind it or causes them to seem shadowy if they are transparent. An intelligent woman, afflicted with periodic insanity, lying in a dormitory, was under the delusion of being in a subterranean passage and about to undergo execution, and afterwards explained, in answer to my questions, that while in this hallucinatory state she neither saw the ward with its bed nor heard the noise of patients in the adjoining room."

At my request, Professor Forel was good enough to experimentalize further, and doing so with a suitable, altogether trustworthy post-hypnotic subject, he succeeded in inducing the hallucinatory vision of a parrot, so strong and so untransparent that behind this imaginary bird a sentence in large letters on a white sheet of paper remained legible only where the parrot did not cover it!

It is obvious that a similar competition must arise not only in the optical region but in every other one when several qualitatively distinct original and mnemic sensations (or even several such mnemic sensations alone) are simultaneously ecphorized in the same field. (Where there is no qualitative difference the result would be homophony.)

Thus I am myself able to induce a mnemic sensation of cold in any particular part of my skin; for instance, I can what is called "represent" a sensation of cold in my finger-tips. But this attempt miscarries entirely, or the already induced mnemic sensation vanishes immediately, whenever an original sensation of different sort intrudes into the same field of sensation by my squeezing the spot or stimulating it with a hot current. It is true that if the stimulus is particularly weak, or, better, if the represented mnemic sensation is very vivid (as in cases of hypnotic suggestion), then the mnemic can assert itself against the original sensation. But this happens through extrusion from the common field of the original sensation; and thus we get another proof that under certain circumstances real competition reigns—a true

alternative is set up. The same result follows from similar experiments in all regions of sensation. Only in the case of hearing the effect is so far different that, as shown in the note at pages 104–5, it is equally impossible to produce within the same field qualitatively different sensations of sound, whether original or mnemic. Between these there can be no competition, and one can hear an original tone and at the same moment quite easily a mnemic one entirely differing from it.

Between different auditory sensations simultaneously set up, be they original or mnemic, there is therefore never any struggle for a place in the field, only rivalry in degrees of vividness. As we saw above, defeat in this matter of vividness can lead to a factitious elimination of certain components; but there is in this case no absolute alternative, only an optional, not unconditionally determined, mutual exclusion.

Let us now sum up the result of the foregoing observations in the two following formulations:

1. Given the conditions for a simultaneous setting-up of different sensations, the products of this setting-up, in so far as they are felt in side-by-sideness, are all more or less engaged in rivalry for degrees of vividness. They *may* exclude one another, but in the majority of cases need not do so. We may describe these cases as being *a rivalry for degrees of vividness among the components of a side-by-sideness.*

2. Where there is no possibility of *side-by-sideness* among the components and they are assigned to one and the same field of sensation (or to one and the same complex of fields), then, if there is sufficient qualitative difference, what happens may be described as *competition for a place in the field of sensation.* The competitors can, however, be either two original sensations set up from corresponding gates of stimulation (corresponding sensations of sight and smell, but not corresponding sensations of hearing, as these are always qualitatively similar) or, on the other side, an original and a mnemic sensation;

or, finally, different mnemic sensations can all compete with one another.

Speaking particularly of mnemic sensations, it is evident that when any of the above-mentioned combinations are present themselves, the conditions of ecphory and duration of mnemic sensations are manifold: (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. It would be a fruitful and not over difficult task to bring together all these possibilities and to study them systematically. But it would take us too far from the general questions which we are investigating in this work with the object of elucidating further the wider aims embodied in *Mneme*. With a view, therefore, to the economy of our whole task, we must give up any further exploration of a partial region.

We will only direct attention to one particular group of cases, because they throw light on certain important mnemic problems. I refer to what I described in *Mneme* as alternately ecphorizable dichotomies. It was in view to its fundamental importance, especially in questions connected with growth and regeneration of organs, that in my previous book[1] I devoted so much attention to this question of alternating ecphory of engram-successions. But it may be useful to complete the explanation there given with reference to manifestations in sensation of alternately ecphorizable dichotomies of engrams.

We may link on with the results of our investigations as summed up briefly at page 311 of this chapter. What we had in view in the theses there stated, as well as in the concrete cases whence these were derived, were the components and conditions of a synchronous complex of sensations; we were not dealing with a *succession* of sensation-complexes.

Now it is obvious that the rules governing internally

[1] *Mneme*, kap. xiii.

each complex take on no new features if we leave analysis for synthesis to the extent of considering not merely an isolated simultaneous complex but a whole succession of complexes. We might, indeed, extend our thesis of the simultaneousness of two momentary states of consciousness to the simultaneousness of the course of two chains of sensation composed of varying elements. Instead of two simultaneous states of sensation, we are now dealing with two temporally parallel chains of sensation in competition for degrees of vividness; and the share of one competitor may be so small as hardly to reach the upper consciousness—indeed, may not be manifested at all. But there are other circumstances when a true competition between successions of sensations takes place, and then, as we saw at page 311, any *side-by-sideness* becoming impossible, there arises a sharply defined alternation between the successions, usually ending in a distinct victory of one series over another, or only exceptionally with a fusion (but never with side-by-sideness).

In one series of cases, therefore, we have competition for degrees of vividness resulting in equal or unequal sharing, sometimes in the total exclusion of one component, while in another series there is a genuine struggle, ending in definite alternation. Now all this happens:

either between two original successions

or

between an original and a mnemic succession

or

between mnemic successions.

We will take only the last case into consideration and select one only out of the manifold forms in which it may appear, viz., that in which the two struggling successions possess a common initial member (or a common chain of initial members).

Let me start from the concrete example used in *Mneme*.[1] There I said:

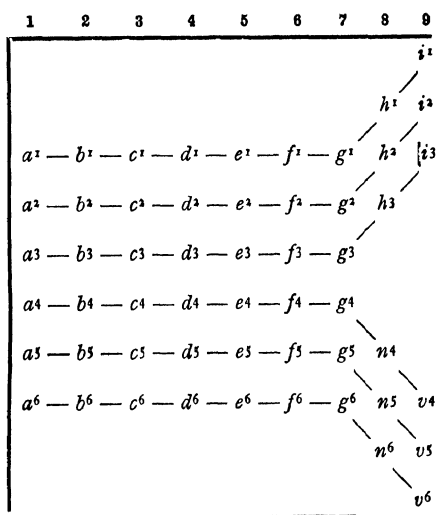
"On hearing or reading the well-known poem 'Über

[1] 2 Aufl., SS. 146, 221. English translation (by L. Simon), p. 111.—TRANSLATOR'S NOTE.

allen Gipfeln ist Ruh,' now in the first and now in the second of Goethe's versions, I receive the impression of the following alternating form : [1]

Über allen Gipfeln ist Ruh, in allen { Wäldern hörest du keinen Hauch. / Wipfeln spürest du kaum einen Hauch.

There remains consequently in the engram a dichotomy which, from the point of bifurcation, can only be alternately ecphorized. To make the example clearer, let us suppose that each version has been already three times present to us, and give to the letters the index number corresponding to their repetition, whereby, when taking into account only the succession of the first nine engrams, we get the following scheme of homophonously ecphorizable engrams :



[1] Mr. Louis Simon in his translation of *Mneme*, wherein the same example of dichotomy occurs, instead of the German form quotes an alternative from Omar Khayyám as follows :

The Sultan's Turret { in a noose of light / with a shaft of light

—TRANSLATOR'S NOTE.

When ecphory occurs, the phases 1–7 of the mnemic sensation (a^1–a^6) (b^1–b^6 to g^1–g^6) follow regularly one after the other. In phase 8, however, occurs an alternative; there either the engrams (h^1 h^2 h^3 = Wäldern) or the engrams (n^4 n^5 n^6 = Wipfeln) are ecphorized. Why does this alternative come about? In *Mneme*[1] I have answered: "Because in such a case simultaneous manifestation of the branches of a dichotomy composed of word-engrams is impossible." I now want to modify somewhat this pronouncement and to reply in fuller and more definite terms to the question. As a fact, 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. The following experiment will show this. Rattle off aloud some poem so familiar that you could almost repeat it asleep; at the same time, but only mentally, recite another piece as well known as the first. Personally, I am able to do this within certain, though narrow limits. For I succeed in getting an undoubted side-by-sideness only for a very short time; either the spoken recitation sticks or, if I attend to that, the other purely mental reproduction stops short; or else what happens is that by jumping from one to the other I keep up both rather badly. Such passing from one to the other invalidates the experiment as proof of a real side-by-sideness, since what happens is oscillating ecphory and a peculiar form of *sequence*. Nevertheless, 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. It is true that in the case under examination the manifestations are of different nature, one series being manifested by consciousness of sensations, the other manifested only through simultaneous motor reactions. But the presence of conscious sensations, however slight, while one is rattling off a poem

[1] *Mneme*, S. 222.

mechanically with the mind fixed on something else is not to be denied, and consequently we must admit that the alternative is here not so stringent as if one were requested (which is impossible) to perceive consciously and simultaneously in the same part of the visual field two separate opaque images (original-original or original-mnemic or mnemic-mnemic).

But even if there be no absolute impossibility of simultaneous manifestation of ecphory on the part of two different verbal engrams, nor even of their manifestation in sensation, there is yet a relatively distinct if not quite unconditional alternative in this case of two memorized versions of Goethe's poem; and generally in the great majority of cases offering dichotomous (or trichotomous, etc.) ecphory of bifurcating series of engrams. And this happens for particular reasons which we will now briefly review.

Take a case which presents no inherent difficulty whatever in ecphorizing side by side and bringing side by side into lucid consciousness both branches of a dichotomous series of engrams. This, for instance, occurs with two different tone-sequences. Composers often make use of three different musical themes simultaneously.[1] In this form the themes are "sensed"; they act engraphically and are ecphorized by musically endowed persons in an exact side-by-sideness. Consequently, although there is no impossibility and not even any difficulty about the simultaneous procession of two different acoustic sequences, yet the phenomenon only takes place when the original stimulus has been simultaneous in both and when both sequences have been already simultaneously engraved on the organism. In other cases the ecphory is alternate.

Take as a concrete example the following tone-sequences in Beethoven's well-known sonata:

[1] Almost any one of the fugues of Bach's "Clavecin bien Temperé" gives examples in point, as may be perceived by the first glance at the printed notes. But to distinguish *by ear* the simultaneously running themes, especially when these are more than two, requires musical training and an exacter knowledge of the score.

First Sequence.

Second Sequence.

The two form, in so far, form the following dichotomous engram :

$$g - b - d \begin{cases} e - d - c - b - g \\ cis - c - a - g \end{cases}$$

So that if you ask anyone acquainted with Beethoven's music to continue after you have played him the commencing sequence *g–b–d* in the proper rhythm, he will certainly reproduce either the sequence *e–d–c–b–g* or *cis–c–a–g*. Possibly he may hesitate a moment before choosing one of the two branches. But under no circumstances would he ecphorize, however silently, both branches simultaneously, or construct a tone-pattern of the following mixed description :

although such a tone-pattern would offer not the least difficulty in sensation or reproduction and could be formed without difficulty in the case of an original composition.

The reason for this is in my opinion as follows :

Rivalry for degrees of vividness prevails in the side-by-sideness of all simultaneous sensations of different contents, and the rivalry is liveliest when taking place between the components of one and the same region of sensation.[1]

[1] While it is almost impossible simultaneously to ecphorize and to feel side by side two heterogeneous tone-sequences, there is no difficulty in obtaining the concurrent production of two

One might not expect this to happen in the case of two simultaneous original tone-sensations, but nevertheless it is an obvious fact that in polyphonic music we fix our attention always upon relatively few components, and that a peculiar effort or great habit is necessary to take in the different parts equally. If I hear the mixed form mentioned at page 317 as original sensations, the competition among these, which would otherwise be so marked, diminishes and ends with the composite form of side-by-sideness in which almost invariably one component overbears another—a fact which we can observe in all mnemic reproductions, and even more in what we "forget" after a long lapse of time. But when we have never heard the two tone sequences together (or read them, which for a trained musician comes to the same thing), then ecphory results in the dichotomous engram:

$$g - h - d \begin{cases} e - d - c - h - g \\ cis - e - a - g \end{cases}$$

with competition after *g–h–d* between the purely mnemic acoustic sensations *e* and *c* sharp, and in the end regularly with total defeat for the representative of one succession of tones.

Only a particularly musical person can achieve some other result by bestowing equally vivid attention upon

different series of sensation in side-by-sideness if only they belong to quite different regions of sensation. Say, for instance, that I can vividly call to mind, i.e. to my mind's eye, some fine waltzes I have seen at a ball, while unable to remember the music to which they were danced; well, it will be the easiest thing to replace the forgotten waltz-tune by some other remembered waltz-tune and accompany with *its* mnemic succession the mnemic visual images of the dance originally accompanied by the forgotten music. Paulhan (*Revue Scientifique*, vol. 39, 1887, p. 684) has given a number of interesting experiments by which he brings into sharper scientific relief the obvious fact that simultaneous mnemic processes belonging to neighbouring regions of sensation are easier to contemplate together than those which occupy quite different areas.

both branches of the dichotomy. Such a person would certainly be able to ecphorize the form given at page 317 as that of a mixed side-by-sideness. But he would have to exercise considerable effort, and even for him, as for average mortals, there exists in these cases a definite if not an unconditional alternative.

But if, as we have seen, it is uncommonly difficult so to equilibrate the mnemic reproduction of tone-engrams as to ecphorize both branches of the dichotomy side by side, while a similar attempt in the case of word-engrams and many other long sequences is quite fruitless, it yet often happens that by jumping from one ecphorized engram-branch to another one can get a *mixed reaction* And this is more frequent in the reproduction of words, syllables, or with kinæsthetic reactions than with others. In *Mneme*[1] I remarked on this very point: "We have an example of such mixed reaction whenever, as may eâsily happen, we combine the two alternatives as follows: 'Über allen Gipfeln ist Ruh,' 'in allen Wipfeln hörest du kaum einen Hauch.'"[2] Such mixed reactions are rare neither in the expression of an individually acquired mneme nor in the manifestation of inherited dichotomous successions of engrams. However, in the majority of cases, and whether the alternative dichotomy be inherited or individually acquired, it happens that ecphory follows at one or the other path at the forking of the ways, and in the case already mentioned[3] of the homophonous engram either h^{1-3} or n^{4-6} is ecphorized. The reply to this mnemic alternative depends on whether the ecphoric influence of h^{1-3} or that of n^{4-6} predominates, and factors of the most various kinds may cause the balance to sink on one side or the other. In the majority of cases the greater weight is already predetermined on one side or the other because the number of repetitions is usually not so entirely equal as we assume it to be in our schema. A further

[1] *Mneme*, S. 223; 2 Aufl.

[2] Or, as in the alternating form given by Mr. Louis Simon (see p. 314).—TRANSLATOR'S NOTE.

[3] P. 314 of the present work.

weight on one side is caused by the later-dated and less blurred repetitions. Such factors, as we shall later see, as a rule bar the approach to atavistic paths. Add to this that new original stimulations of all kinds can compensate to excess any overweight previously present on the other side. A reciter acquainted with two readings of a poem, but accustomed to recite it in the one form, can sometimes be induced to choose the alternate version by one prompting its first word at the point of forking, as " Wäldern " instead of " Wipfeln " in Goethe's poem.[1] That under certain circumstances there exist inhibiting influences which prevent one path at the fork from being entered or pursued, and which consequently lead to ecphory on the other side, is a point to be explained in detail later in a chapter on " Morphogenetic Dichotomies."

The facts on which in the previous chapter we have relied for our investigation of sensations manifested in alternately ecphorized dichotomy are of a kind which every reader must often and clearly have experienced in his own person, and can at any moment verify for himself. In addition, we possess a carefully sifted collection of experiments for which we have to thank G. E. Müller and his fellow-workers, F. Schumann [2] and A. Pilzecher.[3] Especially in Müller and Pilzecher's work, a large space is devoted to investigation of the interaction and rivalry between simultaneous mnemic excitations and sensations. These authors distinguish a " generative inhibition," when the engraphic action of particular excitations is weakened by the presence of other mnemic excitations and sensations, from an " effectual inhibition " when the presence of one mnemic excitation impedes the *ecphory* of another, either by delaying it, lessening its vividness

[1] Or " in " instead of " with," as in the quotation from Omar Khayyám.—TRANSLATOR'S NOTE.

[2] G. E. Müller and F. Schumann, " Experimentelle Beiträge zur Untersuchung des Gedächtnisses," *Zeitschr. f. Psych. u. Phys. d. Sinnesorgane*, Bd. 6, 1894.

[3] G. E. Müller and A. Pilzecher, " Experimentelle Beiträge zur Lehre vom Gedächtniss," *Zeitschr. f. Psych. u. Phys. d. Sinnesorgane*, Ergänsungsband I, 1900.

or preventing it altogether. It would lead us too far to go closer into the numerous experiments made by G. E. Müller and his fellow-workers, with the many remarkable details they obtained. But I would particularly refer to the interesting section on the "mixed working of competing associations"[1] which deals with mixed reactions in the sphere of words and syllables; and I would also draw attention to mixed reactions in the form of mixed *movements* mentioned by Münsterberg.[2] As regards the reactions from which we infer the existence of dichotomous successions of engrams and of the alternatives in their ecphory, together with the different sort of response or compensation in such alternatives, the last-named experimental investigations are primarily concerned with motor reactions. It is true that in many cases the investigator also interrogated the experimental subject concerning his synchronous sensations, and so got at the process of excitation by a double testimony. I have shown in detail in *Mneme*[3] that such interpretation is equally valuable whether based upon sensory, motor or plastic reactions or on metabolic ones. But only when we consider the consequences of all this various testimony taken as a whole can we measure the full significance of the alternately ecphorizable dichotomy.

The most important consequences arising out of such a co-ordination of engrams are not, however, to be drawn from the region of the individually acquired engram-store which has exclusively occupied us in this work, but rather from that of the inherited engram-store. Here, especially in the study of ontogenesis, a correct conception of the nature of alternatively ecphorizable engram-dichotomy and its uprise is the key to numerous most important problems of heredity—problems which to-day are of central interest in connection with the meaning of the Mendelian rules, the apparition of atavism, the hybridization of

[1] Müller and Pilzecher, *ibid.*, pp. 159–65 and 225–30.

[2] H. Münsterberg, *Beiträge zur experimentelle Psychologie*, Heft 4, p. 78, Freiburg, 1892.

[3] *Mneme*, S. 214–15; 2 Aufl.

species considered as a determinant of reaction, etc. In all these questions we have to deal with mnemic alternatives, their decisive responses or their mixed reactions caused by compensatory processes.

Since every union of two germs, being the conjunction of the inherited engram-store of one parent with that of the other, brings with it an abundance of new alternatives which easily explain the phenomenon, we have only to follow the line of our investigations to see plainly on physiological grounds the mixed constituents in which the inherited qualities of every human creature, indeed of every organic structure, manifest themselves in bodily build, in instincts, disposition and character.

Further examination of this point lies outside the scope of the present work. But the fundamental significance of mnemic alternatives in this connection is indicated by the remarks I have devoted to it in the twelfth and thirteenth chapters of *Mneme*. There I have indeed given only the ground-plan; but new explanations will open out abundantly once the problem is studied in detail from my standpoint and with the assistance of the results embodied in this work—a task I hope to undertake in the future.

NINETEENTH CHAPTER

SIGNIFICATION AND CO-ORDINATION OF RESULTS

IN *Mneme* I summarised as follows the chief result of that work: "Inasmuch as this investigation has revealed to us that all these apparently heterogeneous manifestations (of mnemic excitations) are ultimately referable to laws of association and laws of homophony, which are themselves deducible from modes of synchronous stimulation, it appears to me that such a co-ordination of points of view does represent a step in the knowledge of reality."

The present work has dealt particularly with but a small part of the wide region of the "Mneme"—that region which, manifested in superliminal individually acquired sensation, we may call the sphere of higher memory.

I wish to devote this concluding chapter to demonstrating how far, in the limited path traversed, we have successfully reduced to a minimum of simple principles an extraordinary number of apparently different processes and, by combining and co-ordinating our views, accomplished one more advance in the knowledge of reality.

I have always affirmed[1] the essential characteristic of all mnemic processes, in their widest sense to be that, considered as reproductions of earlier phenomena, they arise without the complete repetition of the conditions which had been necessary in the case of those

[1] Cf. besides *Mneme*, the essay "Kritik u. Antikritik der Mneme," in *Archiv f. Rassen-u-Gesellschafts-Biologie*, 2 Heft, 1907, S. 205.

earlier phenomena by which they were preceded. But the possibility of eliciting the mnemic phenomena (their ecphory, that is) is absolutely dependent upon the previous presence of those preceding phenomena. This absolute dependence can be best expressed by saying that the predecessors or original excitations have left behind them what we call engrams, that is enduring changes, in the organic substance and that the presence of such engrams or modifications in the organic substance suffices through a partial return of the energetic situation (working engraphically) to reproduce completely, although with much diminished liveliness, the previous group of phenomena.

This relationship contains the basic principle of all mnemic phenomena. In the present work I have formulated this basic principle in two theses which I entitled the two main mnemic propositions. They hold good for all mnemic phenomena, not merely for those belonging to the higher memory and manifested in superliminal sensations; and for this reason in defining them I speak only of the excitation to which they are due, and not of the various modes of their manifestation.

First main mnemic proposition (*Engraphy*).—All synchronous excitations within an organism form a connected simultaneous complex of excitations which, as such, act engraphically, that is to say, they leave behind them an engram-complex which, to the extent of such action, is a whole.

Second main mnemic proposition (*Ecphory*).—The partial return of the same energetic situation which has once acted engraphically on a simultaneous engram-complex causes ecphory. Or more definitely expressed: Echpory of a simultaneous engram-complex follows on the partial return of the excitation-complex which has left an engram-complex behind it, whether the said return be that of original, or of mnemic, excitations.

It is obvious that these two propositions are intimately bound up with one another, and can only, when united, express the quintessence of fundamental mnemic laws.

For it is only through ecphory that we first get to know the existence of engraphy, and there can be no ecphory unless preceded by engraphy. On the other hand, both propositions when so expressed enable us to distinguish sharply between engraphy in all its manifestations and ecphory.

From our law of engraphy there directly proceeds what is meant by association, that is connection between the several components of an engram-complex.

As our first main proposition teaches that the components of an excitation-complex constitute a whole and that the same is true of the engram-complex which it left behind, we cannot fail to see that union, under certain circumstances, of several engram-components, whose separate rise occurs through the breaking-up of every simultaneous mnemic complex (for which see p. 161), is inevitable and obvious.

This union, this association of engram-components, is shown, it is true, only through a new ecphory. The fact of the binding-together of engram-components, which alone deserves the name of *association*, should, logically, be sharply distinguished from this ecphoric process through which the fact itself is revealed. *Briefly, association is the result of an engraphy disclosed on the occasion of an ecphory.*

This state of affairs does not seem to have been clearly apprehended up to now, and usually "association" has been employed in two senses, first, quite correctly, as the complete union of engrams or mnemic sensations (latent or actual representations); secondly, also, as the process whereby this union becomes apparent. This inconsequent phraseology is the source of numerous misunderstandings and fruitless discussions, which have grown up especially around the concept of "association through resemblance."

This latter concept is a changeling born of applying the word "association" in a double sense. And the confusion thence arising has been favoured by the following complications:

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. As a phenomenon consequent on this ecphory we get the simultaneous presence of the elemeuts of both groups in one and the same simultaneous excitation-complex, and thus there arises simultaneous association of the engrams deposited by both groups of components. Resemblance therefore conditions ecphory, and ecphory creates a new shape which is simultaneous association. I have already (p. 188) given an illustrative example of this; and another example on pages 173–4 can serve the same purpose.

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. Strictly speaking, there exists only one kind of association, that which is deduced from my principal proposition and which, that formula makes us infer, is *association by simultaneity*. Anyone who agrees with me in seeing as the essence of ecphory the partial return of a particular energetic situation will understand at once that this partial return may well be limited to such elements of the situation as are not manifested as superliminal "ideas." This is the explanation of chronogenous ecphory, of the ecphories too of vague feelings and mere moods and what Herbart calls "spontaneously occurring representations."

If we consider the total result, at any given moment, of all the engrams deposited throughout the individual life of any organism we shall have what has been more especially investigated in this work, namely, the individually acquired engram-store. The engram-store which is, on the contrary, inherited has not been dealt with in this present volume.

We have seen that the individually acquired engram-store is formed by simultaneous engram-complexes linked to one another in a continuous series. Having arisen, as

formulated in my first chief proposition, each simultaneous complex goes to constitute what is in a certain sense a coherent unity. This is formed of different components which are partly the traces of original, partly of mnemic, excitations. 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. But a considerable proportion of the components of one layer finds its way unaltered into the next and eventually into succeeding layers, and this continuity, while, of course, exhibited in weakened form, is favoured by the fact that every original excitation outlives in its acolu-thic phase the stimulus which has given it birth. We are thus able to reduce "successive association" to "simultaneous association." The association of two engrams is therefore, and without exception, the result of the contemporaneous conjunction of their "ascendants" in the same simultaneous excitation-complex. Fundamentally, association is merely association by simultaneity; association by succession is only a secondary species.

Special qualities of the individually-acquired engram-store (whether this be referable to the standardization of such cyclic processes as circulation, respiration and metabolism, which is explained by our first proposition, or whether they be consequent on certain peculiarities inherent in all cyclic phenomena) furnish us with the solution of the important question, Why *the course of mnemic processes as such are not reversible?* I will not pursue this subject any farther nor dwell on the other peculiarities and the special importance of the individually acquired engram-store. My purpose has been only to give in outline the reason why the majority of all mnemic processes, whether in their governing prin-

ciples or their special characters, are simply and obviously derived from the fundamental mnemic law brought forward by us and expressed in our two chief propositions.

But, in connection with the individual engram-store I wish to devote a few words to the special point of its localization in the stimulable substance of the organism. In different passages of *Mneme* and of other publications I have raised the question whether we cannot formulate in some precise, scientific way the nature of the alteration in the engram which every new excitation leaves behind it in the form of a potentiality of that engram. When I defined the engram as a durable but (till the next ecphory) latent modification which the energetic process of stimulation leaves behind it in the sensitive substance, this definition implied that this modification of the "substance" must be understood as a substantial or material change. What its precise nature may be I find it impossible to say, nor do I think that science gains anything whenever, instead of such impossibility being recognized, speculations concerning molecular change are indulged in apart from any experimental groundwork for such hypotheses. It is none the less obvious that we are in the presence of *material* changes of organic *substance*, that is, changes of a physical, chemical or physico-chemical nature. And our only right course is to admit that up to now our knowledge of the nature of such structural alterations can only be expressed in these general terms.

This view of mine—which is simply a reservation of judgment—has, I must say, been cruelly misunderstood by some of my critics. One of these lays hold of this view in order to accuse me of vitalistic tendencies, although I have always treated vitalism as the worst backsliding into which scientific thought can degenerate, expressing myself uncompromisingly in this sense. If the admission that we are still enormously removed from the goal (not in itself to be pronounced unattainable) "of being able to describe all the manifestations of life in purely physico-chemical terms"—if such an

admission were tantamount to belief in vitalism, then vitalism would far better justify its existence and be infinitely less harmful than is actually the case. Then every scientific investigator of Life's processes would have to be described as a "vitalist," since throughout the world none could be found to refuse making this admission. But there is no such innocence in either the old vitalism or the reinstated vitalism of to-day. For if the term is really to be taken as having a scientific meaning it can only imply that there lurks in vital processes a something, a living residuum, in a word, a mysterious vital force *which cannot be referred to any physico-chemical phenomena and which differs from such not only by its complex structure but in its very essence.*

Another critic, finding that I refuse to discuss all hypotheses based on atomic changes, discards my views as incapable of being intelligibly represented. This is much as if a man were to wave aside the results of investigation into the physiology of muscles, because so far we have no plausible explanation of the basic phenomenon of muscular contraction, or as if he were to hesitate about the scientific fact of gravity because he cannot "represent" to himself how bodies come to have the quality of attraction.

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 naïvely 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.

Instead of thus dealing with molecular hypotheses, I particularly addressed myself in *Mneme* to one structural

question respecting the engram-store, viz. its localization. And, as regards the individually acquired stock of engrams, I set forth the conditions from which it incontestably results 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."[1] To this inquiry, under the title "Gradual localization of individually acquired engrams," I devoted a large portion of the fifth chapter of *Mneme*, and there described a particular form of localization to which I gave the name of *topogenous* —a form which, as I there said, is a gradual one.

In the course of the present investigation we have got to know a second principle which is important for the localization of the engram-store. In contradistinction to *topogenous* we called this form of localization *chronogenous* and inferred its existence first from the whole nature of the individually acquired engram-store, and next from sundry details of the pathology of memory (see pp. 260–61). Our investigation therefore brings us up against results which, for the present at least, conduce to a complication, not to a simplification, of our problem. I fully admit this. But whether this particular complication may not prove the starting-point for fuller inquiry into the riddle of localization can only be learned through further investigations conducted from our new standpoint. This is the place to remind ourselves that an important simplification in the subject of engraphy of numerous simultaneous excitations results from our recognizing the fact that in homophony, formation of differentials, in strengthening and weakening through contrast, and in fusion of the various stimulations, it is only the then obtaining resultants of the complex energetic interplay which are able to exert engraphic activity (cf. p. 301).

The above summary has shown that the ground-plan

[1] *Mneme*, 2 Aufl., 1908, S. 159. English translation by Louis Simon, p. 120.—TRANSLATOR'S NOTE.

of our theory of mnemic sensation can be deduced, without recourse to hypothesis, solely and decisively from the fundamental law formulated in the two associated mnemic propositions, viz. of engraphy and of ecphory. However, there remains another chief problem which cannot be explained by the consequences of this basis, but imposes further investigation. This remaining problem is that of homophony. In *Mneme* I stated and treated in detail, both analytically and synthetically, the concept of mnemic homophony. The present work is partly due to my conviction that this previous handling of the subject was not exhaustive. I have since come to see that homophony extends beyond the mnemic region and that it can occur not only, as already recognized in *Mneme*, between mnemic sensations alone or between mnemic and original sensations but also takes place between original sensations alone.

To get a perfect outlook on the whole problem, it became requisite to pass to a wider standpoint. Starting from the recognition of side-by-sideness among the various components, both original and mnemic, of a synchronous sensation-complex, we were led to the concept of *fields of sensation*. Thereby we gained a fundamental enlargement of our conceptions of the whole region of sense—a widening not indeed of the literal notion of space as such but of that which underlies this literal space in all regions of sensation. We found, in fact, that all sensations, not only those of touch and sight, are, in a certain sense, spatially determined, and that such determination is genetically connected with the gates of stimulation through which sensations issue.

I attempted to express this by saying that every sensation, even every auditory and olfactory sensation, *appears in a particular field of sensation*. It is true we are not usually able to bring the different fields of sensation-modalities into relation with one another. For while the relation between the fields of sight and those of inner and outer touch is easy to grasp, and we build

up thereon our idea of what we commonly call "space," the fields, on the other hand, of the sensation of tone and smell (the latter set free by inhalation) [1] are closed to one another and shut off from "common (or tactual-visual) space." The gate of stimulation through which an original sensation is admitted decides the locality of its "sensation-field"; and in the case of a mnemic sensation the same gate of stimulation through which the original entered serves for the ecphory of the engram, and thus similarly determines the sensation-field of the mnemic sensation.

The distribution into fields of all simultaneous complexes of sensation results, on one hand, in the fact of *side-by-sideness* and, on the other, in homophony of original as well as of mnemic sensations. I must refer to the explanations given in the present work for proof of this assertion. I will now only repeat in general terms the derivation of our theory of homophony.

Homophony is the condition arising whenever sensations qualitatively similar appear simultaneously in the same *field of sensation*. This meeting may take place between original or mnemic sensations or between the two kinds together. And as qualitatively similar sensations are almost always slightly different from one another, such perfect congruence as constitutes real homophony can only occur where components are identical in every respect.

Where diversities between components or groups of components vanish we get that which I have called "non-differentiating homophony." When, on the other hand, the partially dissimilar components are brought into opposition with one another there is "differentiating homophony."

A result of non-differentiating homophony is *abstraction through homophony* (what I formerly named physiological abstraction), which constitutes a first degree of what is usually called abstraction—a degree achieved by many of the more highly organised animals.

[1] With insects endowed with Forel's "topochemical" sense the case is doubtless different. See above, p. 86.

If the unlike components of two otherwise homophonous complexes of sensation, or of two complexes similar in all respects except in "intensity," be brought as a whole into opposition with one another (in opposition, however, which never includes more than two groups) what happens is the creation of a differential of sensation. Differentials of sensation in stereoscopic experiments and binocular "dazzlement" are differentials in the homophony of original sensations. A differential arising not from opposition among several diverse components but only between two sensations of tone equal in every respect except "intensity" is manifested by the sensation of direction in sound. When there is homophony and opposition between original and mnemic, or exclusively between mnemic, components the result is the differential-sensation of "recognition" as well as of finding a "difference." It is in the fineness of the sensation of difference in homophony that lies the great superiority of homophonous comparison over comparison in *side-by-sideness.*

For more thorough understanding of the nature and genesis of sensation, in my opinion it will be necessary to obtain by means of new experiments a much wider view of the phenomena of *competition* than, despite the consideration we have bestowed upon it, has been possible in this book. Among the results already acquired what seems to me of special importance is the proof (furnished in part by Forel's observations and conclusions, see pp. 309–10) that an equally typical form of competition arises between a mnemic and an original sensation (also between two mnemic ones) as between two original sensations whenever both though different are yet assignable to the same *field of sensation.* This important conclusion and the general assertion that two synchronous sensations are mutually, necessarily and selectively exclusive lead us to the further conception of *alternatives.*

The question of the nature and rise of alternately ecphorizable dichotomy, with regard to the inheritable

engram-store, is of fundamental importance for many problems of heredity. The answer to this question yields in the first place the key to understanding the results of pairing and crossing, the distribution or mixing of distinctive marks, the Mendelian law, atavism, and so on. All these alternatives are treated in detail in the twelfth and thirteenth chapters of my *Mneme*.[1] The problem is simplified when its study is limited to the individually acquired engram-store, and consequently it has been much more briefly considered in the present work.

The results of this study fall naturally into place and furnish very welcome supplements and elucidations to those gathered in the field of an inherited mneme.

Through a similar investigation into homophony and the problem of competition with which it is so closely connected, we have, it seems to me, brought under the same heading many isolated facts and groups of facts. We thereby recognize how many laws in common govern the phenomena of binocular sight, of di-otic hearing, of smelling with large sections of the olfactory region; those, also, of recognition and sensations of difference, as well as of the reproduction of repeated impressions. These laws are shown to depend directly on the homophonic process which is common to all these phenomena, and equally, whether a differential of sensation results from the non-differentiating or from the differentiating form of this homophony.

Some of the details of these laws, in one or another group of phenomena, have already been studied especially as regards binocular sight. But even there, comprehension of the reciprocal influence of both homophonous original sensations is only possible if we have a thorough insight into the nature of the process of homophony; and this is still more true as regards the remaining sensory fields, both in relation to homophony of joint mnemic and original sensations as of mnemic

[1] English translation by Louis Simon, pp. 221–55. London, Allen & Unwin, 1921.—TRANSLATOR'S NOTE.

sensations alone. Only in this way can we get to thoroughly understand the phenomenon of recognition (a subject which has been approached but not exhausted in the controversy between Höffding and Lehmann), to understand likewise the perception of difference and, above all, to understand the influence of repetition on the workings of memory. Of these it is impossible to have a clear idea unless we grasp the meaning of the homophonous process, failing which we are obliged to fall back upon the metaphor of "deepening the channels," and that is demonstrably mistaken in this connection although generally used.

Finally, our close study of the phenomena of homophony has enabled us to show that the "intensity" of a sensation must be absolutely distinguished from its liveliness or vividness. The two qualities may be associated, but by no means inevitably. By *intensity in the narrow sense* we have expressed that quality of sensation which varies in definite ratio with the strength of a stimulus, for instance, in visual sensation with the degree of illumination; in acoustic sensation with the volume of sound; in tactile sensation with the strength of pressure; in smell or taste with concentration; and in sensation of pain with the degree of keenness. Between the liveliness of sensations and their extent there is no necessary connection. Together with mere intensity liveliness may even be in opposition to extensiveness. But since, as everybody knows from personal experience, liveliness and intensity can in many cases be distinguished one from the other, the essential difference between them must be considered proved by our investigations.[1]

Only by keeping this distinction in mind can we get a clear idea of the essential peculiarities of homo-

[1] Here and there in the literature of psychology we find the statement that the liveliness of a sensation must be taken into account as well as its intensity, but, as far as I know, the remark is merely casual, and not accompanied by any explanation or any evidence of the facts underlying and reinforcing the distinction.

phonous processes as regards binocular sight, di-otic hearing and olfactory phenomena as well as in reference to the part played by repetition as conscious re-presentation. Homophonous congruence of sensation is accompanied by a notable rise in vividness but with none or little in intensity.

The present work has dealt only superficially with vividness in so far as dependent on excitation. Similarly, and in the same dependence, we have not gone into the contrast between vividness and intensity in the narrow meaning.

What we have seen, nevertheless, is that the vividness of a sensation can be heightened by bringing several excitations to bear upon it homophonously; moreover, by concentrating the bulk of the vividness of a simultaneous complex upon a definite portion of the side-by-sideness, upon a minimum of fields of sensation. This proceeding is described as the "action of attention" when we look at the subject from the point of view of sensation rather than from that of excitation. But in neither of these cases is there any increase of intensity worth mentioning, if any at all.

We are finally helped to distinguish between vividness and intensity in the narrow sense by the fact that the perfection of an engraphy depends principally on the vividness and only secondarily, if at all, on the intensity of the excitations. I shall reserve these important questions for fuller investigation, the field of inquiry being far too wide to explore except by slow degrees.

These verbal distinctions between vividness and intensity in the narrow sense and the conception of vividness as an independent quality of sensation are, moreover, important in fixing the characteristic marks which separate mnemic sensations from original ones regarded as direct processes in consciousness. The chief distinction between the two sorts of sensation lies in their usually very different degrees of vividness, not of their intensity; nevertheless, this is not an absolutely con-

stant distinction; there is none such, as we have seen, when the difference of origin is disregarded and the qualities of the sensations directly recognized by consciousness are alone taken into account.

It is often said that, in addition to their lesser vividness, or, as others call it, distinctness, mnemic sensations are distinguishable from original sensations by their lesser duration. This remark is not incorrect *per se*, but it places the facts in a wrong light. It is in the nature of the case that such a faint sensation as a mnemic one usually is should succumb in competition with attention and should sink more promptly below the level of consciousness than would an original sensation. But fleetingness is not on the whole a characteristic of mnemic sensations as such. These have the same duration, taken in themselves, as the original sensations and excitations which have engraphically prepared them. This is shown by the mnemic reproduction of any piece of music. The real characteristic of mnemic sensations is that they are determined in time by the duration of earlier stimulations, while the duration of original sensations depends upon that of contemporaneous stimulations. My preceding chapters have furnished further details on this point. The same applies to the question of the variability in the proportions of mnemic sensations and of their possible reproduction of the absolute *values* belonging to their original predecessors, thanks to some standard of measurement which is transmitted along with them.

The summing-up which I have now brought to a close will, I trust, convince the reader that the whole conception of mnemic phenomena is simplified and unified by their being brought under one fundamental mnemic law and two sub-laws. Furthermore, that a consistent application of the methods I have used to all the sensations, original and mnemic, of our sensorial fields, will put order and unity into the conception of our whole sensory activities and enable them to be more simply and satisfactorily dealt with.

Such a result, such an undeniable psychologic advance, due to the general modes of thinking and the special methods inaugurated in my *Mneme,* would justify the further application which I propose making of them in a future work.

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