PART VI

ON THE FOUNDATION OF PSYCHOPHYSIOLOGY

It is an important principle of physiological epistemology that a phenomenon which occurs generally, cannot possibly be the *specific* function of an organ which is peculiar to a few forms only. (306) JACQUES LOEB

I have observed, as a consequence of serious and repeated emotional shocks, very curious cases of infantilism in adults, where complete amnesia, accompanying sexual inhibition and disturbances of the affective area produced the mentality and conduct of a little child. (411) HENRI PIÉRON

The organism is reacting as a whole to its environment as a whole, and it is doing so in ways that cannot be formulated in terms of an algebraic sum or simple mechanical resultant of the interplay of the simple reflex responses to external stimulation the mechanisms of traditional reflexology seem hopelessly inadequate. (224) C. JUDSON HERRICK

CHAPTER XX

GENERAL CONSIDERATIONS

> We know also how different extra stimuli inhibit and discoordinate a well-established routine of activity, and how a change in a pre-established order dislocates and renders difficult our movements, activities and the whole routine of life. (394)I. P. PAVLOV
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> The experiments show that a compound stimulus the component units of which remain themselves unaltered, and consequently most probably affect the same cells of the cerebral cortex, behaves in different modifications as a different stimulus, evoking in these cells now an excitatory process and now an inhibitory one. (394)I. P. PAVLOV
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> We thus come to the following conclusion: when perfectly neutral stimuli fall upon the hemispheres at a time when there prevails a state of inhibition they acquire an inhibitory function of their own, so that when they act subsequently upon any region of the brain which is in a state of excitation they produce inhibition. (394)I. P. PAVLOV

Some of the most important researches in the function of the higher nervous centres have been done lately by Professor Pavlov in his work on the so-called ‘conditioned reflexes’. This work was developed in a series of papers covering a period of nearly thirty years of experimentation, but the average international scientist did not know this work as an entirety, because the papers were scattered and written mostly in Russian. Only in 1927 did the Oxford Press publish Pavlov’s *Conditioned Reflexes, an Investigation of the Physiological Activity of the Cerebral Cortex* in the English translation of Doctor G. V. Anrep; and in 1928 The International Publishers (New York) published Pavlov’s *Lectures on Conditioned Reflexes, Twenty-five Years of Objective Study of the Higher Nervous Activity (Behaviour) of Animals* in the translation of Doctor W. Horsley Gantt. Both translators were collaborators of Professor Pavlov in Leningrad for a number of years. In these two books, the latest experiments and interpretations are given.

Hitherto, most of the researches on the function of the higher nervous systems were formulated in ‘psychological’ languages, which, obviously, are not fit for physiological disciplines. Professor Pavlov, himself, suggests this fact as an explanation why, until his work, the physiology of the cerebral cortex was so little known. There is no doubt that the descriptive physiological language of happenings, functionings. , used by him exclusively, is responsible for his results. This language suggests structurally new experimentations, which suggestions are lacking in other accounts of the kind where antiquated ‘psychological’ terms are used.

Although I knew as much as the average scientist about the work of Pavlov, this knowledge was not integrated enough to make some

issues clear. But, after I had formulated my $\overline{A}$-system, I read the books of Pavlov and found, to my great satisfaction, that a neurological mechanism, the analysis of which underlies my own work, and the existence of which was independently discovered by me on *theoretical* grounds, had been discovered by Professor Pavlov and his co-workers on *experimental* grounds, thus supplying additional experimental verification for my system.

It seems that the so-called 'ethics'. , in general, sanity, which underlie desirable human characteristics have a definite *physiological* mechanism, automatically involving on psycho-logical levels these desirable semantic attitudes. It appears that some of the psycho-logical problems enormously complex and difficult to reach, or even inaccessible, are solved, not by preaching, but by the most simple and elementary *physiological* training, a fact which has been verified empirically. Obviously, such simplification, if at all possible, must be of fundamental importance.

Physiology deals, in the main, with the functioning of organs in organisms, and results in various formulations. Thus, there might be an hypothetical 'physiological theory of most effective feeding', for instance, stating that food should be secured first in one's hand, or spoon, or fork, before putting it in the mouth, . A group of people who habitually disregarded the 'physiological theory' and abandoned attempts to act in accordance with it after the first unsuccessful one, would be badly underfed or would simply perish. Facts of experience show that some such 'physiological theory' must have been known and applied from time immemorial, and that, perhaps, because of it we survive at all !

How about the 'mental' field ? As I demonstrate—and close observation will verify this very generally—the existing theories of 'mental' life, closely related with our linguistic habits, are *A*, grossly inadequate, and lead to a wholesale production of morons, imbeciles, 'emotionally' disturbed, and, in general, un-sane individuals. Investigation shows the possibility of a simple and obvious *physiological* theory of the use of our nervous system, which automatically leads to desirable psycho-logical, semantic states of general sanity.

In the frivolous example of a 'physiological theory of feeding' given above, the problems of *order* were important. In the physiological theory of sanity, order becomes paramount. Processes and function involve series of states, by necessity exhibiting order. Adjustment to life-conditions means adjustment of processes, and a physiological theory of sanity must be based structurally on four-dimensional order, where 'space' and 'time' are indivisibly interwoven.

Pavlov shows, in an unusually impressive variety and numbers of experiments, how ‘order’ and ‘delay’ (four-dimensional order, in the language used here in this connection) are intimately related with most fundamental processes in the higher nervous centres, and how, by the changes or interplays of them, we can produce or eliminate *pathological states* of the nervous system.

In the human field we find a quite similar situation, unanalysable by older methods, because all order involves asymmetrical relations, which, as we have already shown, cannot be dealt with by *A* means.

The issue is clear and definite: either we persist in our old *A* habits of speech, in which case asymmetrical relations and order evade our grasp, and proper evaluation and sanity are *physiologically* impossible, or we build a $\overline{A}$-system free, or at least more free, from these evaluational limitations, which allows us to deal with order, and sanity becomes *physiologically possible.*

‘Stimuli are never “simple”, and, by necessity, involve fourfold space-time structure and order. Survival values involve, also, this four-dimensional order. For instance, the natural survival order is “senses” first, “mind” next; object first, label next; description first, inference next , . The reversal of the natural order appears pathological and pathogenic and is found as a symptom in practically all forms of “mental” ills, as well as in most human difficulties and disturbances which, at present, are still not considered abnormal. Thus, objectivity is ascribed to words, “mind” projected into “senses”, inferences evaluated as descriptions. ,—quite common “symptoms” . . . Observations on human levels show that we still copy animals in our nervous responses, confuse orders of abstractions (non-existent for the animals), leading fatalistically to the reversal of the natural order and to pathological results, making the great majority of us un-sane.’[*]

A structural *non-el* enquiry into the objective world shows quite clearly that no event is ever ‘simple’; it is, at least, a limited whole of interrelated factors. The eventual ‘simplicity’ is manufactured by a nervous process of higher and higher abstractions.

In our consideration of ‘order’ and ‘delay’, and the role they play in connection with the activities of the nervous system, we must first discriminate sharply between the objective level which is *un-speakable,* because anything that can be said *is not* the object, and the verbal level, on which we can, at will, concentrate attention on similarities, or differences, or both. Secondly, we must pay special attention to structure—

[*] From—Discussion by A. Korzybski. *Proceedings of the First International Congress of Mental Hygiene.* New York, 1932.

that is to say, search for structure in the empirical world, and, once this has been found, adjust, accordingly, the structure of our language.

The structure of the daily, as well as of the 'philosophical', language, which we inherited, in the main, from our primitive ancestors, is such that we have *separate terms* for factors which are not separable, such as 'matter', 'space', 'time', or 'body', 'soul', 'mind', . Then, as it were, we try to make out of the word, flesh, by reversing the natural order and affectively ascribing a delusional *objectivity* to these terms.

If we deal with the silent, un-speakable, objective level and try to divide according to the implications of the verbal division, we find a brutal fact, which, until Einstein and Minkowski, has escaped scientific verbal formulation, that this cannot be done at all. On the objective level every dealing with 'matter' involves 'space' and 'time'; any dealing with 'space' involves some fulness of something and 'time'; and every dealing with 'time' involves 'something' and 'space'.

The structure of the world happens to be such that empirically 'matter', 'space', 'time', cannot be divided; wherefore, we should have a *non-el* language of *similar structure.* This was accomplished by Einstein-Minkowski, when they created a language of 'space-time', in which the hard lumps against which we bump our noses are connected analytically with the curvature of space-time.

In this new, *non-el,* four-dimensional language, every three-dimensional point of 'space' has a date, and so is different. For our purpose, we do not need, at present, to bother much about its curvature or the kinks in space-time, called in the old way 'matter', but we must emphasize that the fourfold order is of great importance, as it corresponds structurally to *experience,* and is intimately connected with physiological reactions, the semantic included.

There is a great deal of confusion about these problems among laymen and also among scientists. From a structural point of view, the issues are quite simple, and there is nothing sensational in the latest announcement of Einstein that 'space' in its importance is displacing 'matter' *(Nottingham Lectures).* Naturally, the statement *in this form* is rather baffling and attracted much—even newspaper—attention. Yet it seems that even the einsteinists do not fully realise the *verbal, structural,* and semantic issues involved.

For the layman, as well as for the majority of the physicists in their less sober, or metaphysical, moments, 'space' is 'emotionally' newtonian and an 'absolute void', which, of course, being 'absolute nothingness' cannot have *objective* existence, by definition. For Einstein, 'space-time' is, semantically, 'fulness', not 'emptiness', and, in *his language,* he does.

not need any term like ‘ether’, as his ‘plenum’, structurally, covers the ground, without his committing himself to a definite two-valued mechanistic ether. The confusion of orders of abstractions, from which we all suffer, is semantic, and is due to disregard of the structure and role of language. If we accept a *non-el* language of space-time, structurally we deal with fulness, and we should not use the term ‘space’, as its old semantic implications are ‘emptiness’ and so are very confusing. The ‘sensation’ of Einstein’s declaration amounts to the fact that the sub-microscopic fulness (‘space’) is more important than a few kinks or concentrations of that fulness (‘matter’) ,—a fact which science has established, and which is quite obvious.

Experiments with ‘conditioned reflexes’ have established firmly the fact that stimuli can be compounded, and that, when established, the compound stimulus acts as a unit, and that a change in the four-dimensional order of factors (including delays) acts as a *different* stimulus, not necessarily resulting in the established reflex. This often introduces great complexities.

As an example of this, we will use the so-called ‘delayed reflex’. When established, the ‘conditioned reflex’ does not appear at once after the stimulation, but after the stimulation combined with the usual ‘time’ delay has occurred, thus showing that the ‘time’ factor plays a physiological role in a compound stimulus. Organisms live in, and consist of, periodic processes, such as the alternation of day and night, sleep, taking in food, heart-beats, breathing, electronic pulsations. ; so that any stimulus, no matter how nominally ‘simple’, is, in reality, a compound stimulus of, let us say, *x* and *y* heart-beats and what not. An organism represents, invariably, a clock of some sort, and, when that clock stops, life ceases.

Under such actual structural conditions a four-dimensional analysis makes every ‘simple’ stimulus compound, and thus four-dimensional *order* becomes a potent *physiological* factor, exerting definite effects. The interplay of four-dimensional order of factors represents, in general, a new stimulus; we have an interplay of positive and negative excitations which may lead to clashes between the two that the nervous system finds difficult to resolve, and so pathological results follow.

If we pass to sub-microscopic levels and processes, we find that, although we may speak of them as ‘chemical’ or ‘stimuli of greater physiological strength’. , yet, by structural necessity, they represent different kinds of *multi-dimensional* order, because, as we say in 1933, the dynamic physical unit of that order is a quantum of action. The metaphysician should not get excited about this statement, because whatever

he might say will also be a verbal statement of a given date, made mostly without any structural considerations, and based mostly upon the reversed survival order, confusion of orders of abstractions and other semantic disturbances. As the world, both outside and inside our skins, is invariably found to exhibit a fourfold space-time order, it is inevitable that this order should be structurally impressed on the nervous system, establishing a natural survival order. Therefore, changes in this order on the macroscopic level, the level of outward events, must have direct inward sub-microscopic effects, disturbing or restoring the nervous equilibrium. This statement may appear innocent; it is not; it has a vital human significance, as it involves standards of evaluation. In short, it means that, in the *actual application* of the consideration of order in education and training on the daily-life levels, we can affect the evasive (as yet) microscopic and sub-microscopic structural levels of the human nervous system, thus directly affecting our *s.r* and behaviour.

To make this clearer, let us recall some of the neurological researches of Bolton (as quoted by Herrick). The cortex has different layers, characterized by the difference in the number, size, shape, internal structure, and density of neural cells. Bolton's third layer of granules divides the cortex into two types of layers. Those closer to the base of the brain, or below the third, are called the infragranular; those above, the supragranular, layers.

The lower mammals show a well-developed infragranular cortex, and a very poorly organized supragranular cortex, the latter increasing in relative size and complexity as we ascend the animal series. On the human level, we find a most important, and usually disregarded, fact—that the human nervous system is not completed at birth but develops structurally years after birth. The above explains why animalistic theories and methods, primitive-made languages of wrong structure, and similar relics, result in training the *s.r* of our children in the patho-

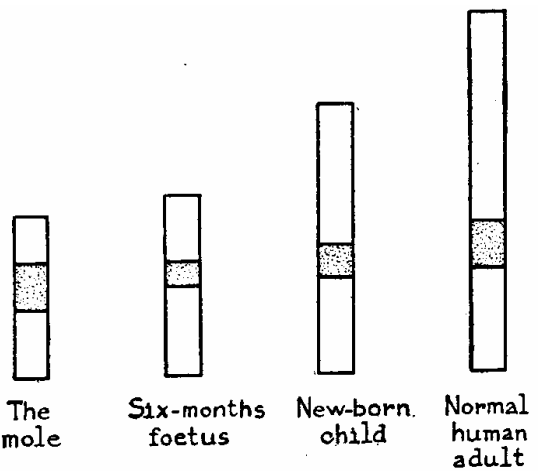

FIG. 1

Diagrams of the relative thickness of the supragranular, granular, and infragranular cerebral cortex in the six-month foetus, the new-born child, the normal brain adult, and the adult mole. The granular layer is dotted. (Redrawn from G. A. Watson (1907), and adopted from Herrick.[1]

logical order, and bring about such great harm, individually and collectively. It enables us to understand, also, why all forms of 'mental' ills invariably exhibit infantile characteristics of some sort.

If we train a child with a physically undeveloped nervous system in animalistic doctrines strictly connected with a primitive-made language of wrong structure, in the pathological reversed order of responses, such semantic training must affect harmfully the still developing nervous system. So, when we say, and demonstrate, that we still copy animals in our nervous responses, we imply an undeveloped or thwarted nervous system, of which the development has been arrested or made regressive. Such a deficiency, of course, is superimposed functionally, and so structurally, upon whatever congenital deficiency there might have been in a given case. We are nearly all in a situation of this kind. We continue to be educated under animalistic conditions since we became time-binders, which, from a biological point of view, is a very recent event, and it is not rash to assume that our nervous system is still not fully developed, the more so that we submit the cortex, which in childhood is still incomplete, to injurious semantic influences. Obviously, such a fundamental human function as language, when used in a way not in correspondence with the structure of the nervous system, must act detrimentally on its development.

In congenital extreme imbecility, the cortex is poorly organized, thin, and deficient in nerve cells, and the infragranular layers show less impairment than the supragranular layers. It seems that Bolton's second supragranular layer is the last to mature, and its relative development corresponds to the relative development of an animal or human being, and, in a way, it goes parallel with the so-called 'intelligence'.

In human defectives, its deficiency corresponds with the degree of psychological arrest, regression, or deterioration. Let us recall that these 'mental' deficiencies, which, in behaviour as well as in nervous structure, take us one step (or several) back toward the level of the infant, or even to that of the animal, are always connected with infantile behaviour in adults, and semantic disturbances.

Nervous as well as muscular tissues have differentiated from the general protoplasm, and we know positively that, through training, we can enlarge or otherwise improve muscular tissues, and there is no reason to doubt that something similar can be done to nervous tissue. All education, and the establishing of any conditional or *s.r*, shows this, although in a rather vague way.

If, by a *physiological* training based on order, we can alter a nervous deficiency, as shown by behaviour, we may conclude that there are physio-

logical means by which we can effectively train and help the development of nervous cells and supragranular layers—or, at least, *not hinder* their natural development. On the macroscopic levels, this beneficial training consists in forming habits of proper evaluation through the natural survival order. The effect of this on the sub-microscopic level is neural, colloidal, and structural, a result which, by the older methods, could not be reached, either with ease or with effectiveness.

Although these conclusions are necessary, it is impossible directly to verify them empirically, because we should have to dissect the brain of a given person before, and during, the training. In this case, as in many others, we have to observe 'human nature' and semantic responses to stimuli of a given individual before and after the training; and, on the foundation of what we know of the development of the nervous system in animals, infants, 'mentally' defective and well-developed adults, build our eventual conclusion as preliminary hypotheses for further structural testing, improvement, and empirical verification.

To realize fully the importance and necessity of this conclusion, we must first understand that, in accordance with the modern discoveries of mathematics, physics, chemistry, colloidal chemistry, and other branches of science, all 'function' depends on *structure,* because the unit-brick of structure represents a dynamic unit of a quantum of action. In the remarks which follow, it is impossible. to be as full and precise as I should like to be, because to be able to do so would be equivalent to being able to solve all scientific problems; yet the reader should realize that the considerations of structure will become extremely creative and helpful as long as we recognise a quantum of action, or any other *dynamic unit.*

We may recall that the characteristics of molecules are due to atomic structure, and that the characteristics of atoms are due to electronic structure. The latest quantum theories also seem to find that the characteristics of electrons are an outgrowth of structure; and, if the suggestions of Dirac are verified, even the difference between positive and negative electricity is structural. Even at present it appears that 'structure' is not only a term fit to handle and explain, but that it has an objective counterpart, allowing a similarity of structure, and, therefore, making the understanding of this world possible.

This last very important semantic point is based on the fact that relations of similar structure have similar 'logical' characteristics, and that, therefore, in structure we find means by which the events can always be made intelligible to us, and so properly evaluated.

Experience—my own, as well as that drawn from scientific literature—impresses me with the fact that we very seldom realize that our

'knowledge' (or, roughly, what we can *say) is not 'it',* as the 'it' is always un-speakable.

Between two houses or two stones, there is some sort of sub-microscopic interaction; but on the macroscopic level, nothing definite happens. So we say that in the given context or configuration, the units under consideration are too heavy (implying gravitational structure), or the medium, the plenum in which they are immersed, is too light (again structural implications) and so, macroscopically, nothing obvious happens.

If that structure is changed, different conditions, different relations and results prevail. Thus, if the particles are very small, and the media not too heavy, the surface phenomena, electrical charges. , begin to play an important role. We then have colloidal behaviour of enormous complexity and variability where we find, not necessarily life, but many inorganic forms, duplicating some forms found in life. Obviously, colloidal structure accounts for that.[2]

When little colloidal wholes, most probably of specialized internal structure, arise, we may have not only colloids, but also little wholes, separated by a membrane, or perhaps by surface phenomena, which represent a most generalised membrane. We may have a new structural fact, an interplay of the inside with the outside, and life begins.

The general irritability and conductivity of protoplasm is known to be strictly connected with permeability to the passage of ions and, therefore, is a structural phenomenon. On this structural foundation, physiological gradients result, forming a dynamic field of forces, again involving structure. The development of the differentiated tissue of muscles and nerves consists of higher order complex structures, based on more primitive structures; and, finally, function and behaviour of all life, man included, is due to sub-microscopic, microscopic, and macroscopic structure.

I may be reproached by specialists that, although what I have just said may possibly be true, yet, actually, to make these assertions is, perhaps, premature, in 1933, because we lack too many details.

My answer is sharp and definite, and may be considered a serious scientific suggestion, because it can be made legitimately in this form:

1) All science depends on human 'knowledge'.

2) All human 'knowledge' is structurally circular and self-reflexive, and so depends on some conscious or unconscious theory of knowledge and undefined terms.

3) Words are *not* the things we speak about; and, therefore,

4) The only possible connection between the objective and un-speakable levels and words is *structural;* introducing

5) Structural analysis of languages as fundamental; making

6) The *only possible content of 'knowledge' structural*, and

7) All science becomes a search for the unknown structure of the empirical world on all levels, and the matching of this unknown structure with the *potentially known* structure of languages; so that

8) All knowledge is hypothetical, in which

9) The most important facts must be *negative.* When the structures do not match, then we learn something quite definite about the empirical structures.

10) All predictability becomes possible because of similarity of structure; and so definitely making

11) All possible aims and quests of science uniquely structural; necessitating

12) Unique methods of translation of dynamic into static, and vice versa, in order to cover the structural exigency of both the dynamic world and the static languages.

13) Such unique methods of translation are given in the differential calculus and four-dimensional geometries, in which

14) What in a four-dimensional language is structure becomes in three-dimensional language 'importing time' function; showing once more that

15) Structural considerations are not only a modern necessity, but also the most creative and helpful for the future development of science and man, and justifying the above assertions, with the setback that

16) Full 1933 structural analysis, being one of the, or perhaps *the,* highest abstraction of this date, the mastering of that language may represent some difficulties.

The reader must be reminded (see, for details, Part VII) that the terms 'structure', 'function'. , are multiordinal terms with many meanings, and so that they have no general meaning apart from context, but have definite meaning in each context. Without this realization of the multiordinality of terms, the statement above could not be made, for it is a structural statement about languages.

As an example of the immense and inherent importance of considerations of four-dimensional order, the following psychological experiment for which Doctor Harry Helson has suggested lately the name of Tau effect, is useful.[3]

If we stimulate three spots of the skin by touching them lightly with the end of a pencil in quick succession, and if the distance between the first and the second spots is, say, 20 mm. , and that between the second and the third is 10 mm. , but the 'time' interval between the second and

the third stimulations is twice as long as that between the first and the second, the distance between the second and the third spots will be judged as nearly twice as great as that between the first and second. Similar results are obtained with other analysers, such as vision and hearing. If we change the conditions of the experiment, the results may be reversed. It is interesting to note that the effect does not depend on ‘knowing’, as similar results happen when the subject knows the conditions of the experiment. The last shows that the experiment deals with a physiological and neurological mechanism. In general terms, if we vary the time-interval in the opposite sense from the space-interval, the latter will be distorted, showing once more the structural fact that in actual life and experience we deal *exclusively* with the four-dimensional space-time order, which, as such, must have physiological and neurological significance, and an adapting mechanism.